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A SURVEY OF COMPUTER PROGRAMMING LANGUAGES CURRENTLY USED IN THE DEPARTMENT OF DEFENSE

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January 1995

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PREFACE

This paper was prepared by the Institute for Defense Analyses (IDA) for the Defense Information Systems Agency under the task order, Ada Technology Insertion, and fulfills an objective, to perform a survey of high order languages currently used in the Department of Defense.

This paper was reviewed by the following IDA research staff members: Dr. Alfred E. Brenner, Dr. Dennis W. Fife, Dr. Richard J. Ivanetich, Dr. John F. Kramer, and Dr. Dale E. Lichtblau.

The authors would like to acknowledge Ms. Jean Sammet for providing many suggestions on improving the data collection form. Ms. Sammet's knowledge of programming languages and their versions was most helpful. Ms. Linda Brown, Ms. Joan McGarity, and Mr. Don Reifer also provided guidance for conducting the survey. The survey respondents should also be thanked for taking time to complete and return the data collection form.

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EXECUTIVE SUMMARY

Background and Purpose

In June 1994 the Assistant Secretary of Defense for Command, Control, Communications and Intelligence commissioned a programming language survey of the Department of Defense (DoD). The purpose was to identify the number of programming languages being used today in the DoD as compared to 20 years ago when the DoD first began developing the Ada programming language.

A 1977 study, *A Common Programming Language for the Department of Defense—Background, History and Technical Requirements*, identified "450" as the minimum, probable number of general purpose languages and dialects used in the DoD, but went on to say that the actual number was not known. How this estimate, and the method used to count root languages, versions, and dialects, came to be is still questioned. For this survey, as part of establishing a strong methodology, counting the number of languages used today required input from the organizations developing or maintaining automated information systems (AISs) and weapon systems. A census sample would include new systems, those being modernized, and those being maintained. For this study, a judgement sample of weapon systems was identified from the 1994 Presidential Budget requests for Research, Development, Test and Evaluation (RDT&E) programs exceeding $15 million and Procurement programs exceeding $25 million. Of the 1,300 programs identified, 423 programs were selected because they included software applications. The current DoD list of 53 major AISs was used as a sample population for non-weapon systems.

Experts in the field of programming languages have differed dramatically in classifying programming languages for counting purposes, particularly in defining the terms "dialect" and "version." For this paper, we use the term "dialect" to indicate a relatively minor change in a language whereas "version" indicates a larger change and usually has a different "name" although the new "name" may only be the concatenation of a different year or number to the baseline name (e.g., Jovial, Jovial 73). We counted a "version" of a root language as a distinct language. The methodology and data collection approach is explained in detail in this report to allow further expansion of the sample population.

Findings and Conclusions

- The estimated 237.6 million source lines of code in this survey are distributed among five generations (Tables ES-1 and ES-2).

Table ES-1. Total SLOC by Language Generation for Weapon System Responses

Language Generation		Total SLOC Reported (in millions)
First		3.90
Second		26.30
Third	General Purpose	148.38
Third	Special Purpose	3.70
Fourth		5.00
Fifth		0.29

Table ES-2. Total SLOC by Language Generation for AISs Responses

Language Generation		Total SLOC Reported (in millions)
First		0.30
Second		0.63
Third	General Purpose	38.24
	Special Purpose	0.00
Fourth		10.81
Fifth		0.05

- There are 37 third generation general and special purpose languages, the latter being used only in weapon systems. (Tables ES-3 and ES-4).

Table ES-3. Total SLOC by General Purpose 3GL for Weapon Systems

Third Generation Language and Version	Total SLOC Reported (in millions)
Ada 83	49.70
C 89	32.50
Fortran pre-91/92	18.55
CMS-2 Y	14.32
Jovial 73	12.68
C++	5.15
CMS-2 M	4.23
Other 3GLs	3.38
Pascal pre-90	3.62
Jovial pre-J73	1.12
Fortran 91/92	1.00
PL/I 87/93 subset	0.64
Basic 87/93 (full)	0.48
PL/I 76/87/93	0.36
Pascal 90 (extended)	0.29
Basic 78 (minimal)	0.17
LISP	0.10
Cobol pre-85	0.09
Cobol 85	0.00
Total	**148.38**

Table ES-4. Total SLOC by 3GL for AISs

Third Generation Language and Version	Total SLOC Reported (in millions)
Cobol 85	14.06
Cobol pre-85	8.59
Ada 83	8.47
Basic 87/93	2.18
C++	2.05
C 89	1.55
Fortran 91/92	0.87
Fortran pre-91/92	0.47
Total	**38.24**

- For both weapon systems and AISs, over 80% of the applications are written in third generation languages.
- There is a greater use of fourth generation languages in AIS applications due to commercial off-the-shelf products for such applications as data management, interactive graphical displays, and editors.
- There is greater use of first and second generation languages (machine and assembly, respectively) in weapon systems than in AIS applications. This difference is due to the use of special purpose embedded computers in weapon systems.
- Most respondents indicated that more than one language is being used in application software. This multi-language use includes languages from all five generations. With modern programming languages and compilers, increased use of COTS products, and re-use of software components, it will become a common practice to produce applications with components written in different languages.

Recommendation

Accepting the number of 450 or more general purpose programming languages in use in the 1970s, we can see considerable progress has been made by the Military

Departments and Agencies in reducing the number to 37 in major systems that are new or being modernized. Yet the survey indicates that a substantial legacy of applications remain that use older versions of programming languages, vendor-unique languages, and military-defined languages. The maintenance costs for these applications could be reduced and their reliability increased by converting these applications to a current version of a Federal Information Processing Standard language. Automated conversion methods should offer a cost-effective technology to facilitate this conversion. Re-engineering these applications in another language is also a cost reduction opportunity. Redundant code can be eliminated, software components can be re-used, and modern off-the-shelf programming tools can be used to improve maintainability and reliability.

Consequently, we recommend that Service and Defense Agency Program Managers regularly review their software applications to identify a migration strategy and plan for upgrading them to current versions of standards-based versions of languages and modern labor-saving tools. The progress in reducing the number of languages used, as shown in this survey, indicates that further reduction should be possible. Indeed, we recognize that several migration efforts are already ongoing now.

1. INTRODUCTION

1.1 Purpose

This paper reports the results of a programming language survey commissioned in June 1994 by the Honorable Emmett Paige, Jr., Assistant Secretary of Defense for Command, Control, Communications and Intelligence, and funded by the Defense Information Systems Agency, Center for Software, DoD Software Initiatives Department. The motivation for the survey was a desire to know how many programming languages are being used in the Department of Defense (DoD) today as compared to 20 years ago when the DoD began development of the Ada language.

1.2 Background

We reviewed studies that preceded and succeeded formation of the DoD High Order Language Working Group (HOLWG) in the mid-1970s to locate a primary source for a list of languages then in use within DoD. Two major software problems were under study at that time. The first was the trend toward unaffordable costs for DoD embedded systems software and the second was the potential proliferation of Service-unique programming languages. Software cost studies of this period did not reference specific programming languages, presumably because software development costs did not appear to vary as a function of the specific programming language being used [AF-CCIP 1973, Fisher 1974]. These studies extrapolated total and projected costs based upon other factors (e.g., labor rates, purchase price, and maintenance costs for hardware and system software used to develop embedded systems).

In 1974, each Military Department independently proposed the adoption of a common programming language for use in the development of its own major weapon systems. The then-Director of Defense Research and Engineering (DDR&E), Malcolm R. Currie, called upon the Military Departments to "... immediately formulate a program to assure maximum useful software commonality in the DoD" [Fisher 1977, p. 7]. The establishment of the HOLWG was the Services' response to DDR&E. The Technical Advisor to the HOLWG, Dr. David Fisher, and the Defense Advanced Research Projects

Agency sponsor, Colonel William A. Whitaker, have written historical accounts of HOLWG activities but these published papers do not document a list of programming languages in use while the HOLWG effort proceeded [Fisher 1977, Whitaker 1993]. However, Fisher's paper, which summarizes the technical requirements for a common programming language, contains the following reference to languages in use:

> There are at least 450 general-purpose languages and dialects currently used in the DoD, but it is not known whether the actual number is 500 or 1500. With few exceptions, the only languages used in data processing and scientific applications are, respectively, Cobol and Fortran. A larger number of programming languages are used in embedded computer systems applications. [Fisher 1976, p. 6]

As part of the present study, Dr. Fisher was contacted concerning the origin of the oft-quoted number of 450 languages being used. He did not recall that a systematic count of languages and versions had been done by the HOLWG. Although there may be papers or reports containing a list of programming languages used by DoD, we were unable to locate them through the open literature resources for use in this study. The analytical method used in the study of DoD software costs approximated the number of compilers installed on general purpose computers. Software cost estimates were derived from analysis of data that the Services were required to report to the General Services Administration under the requirements of the Brooks Act (1965). This data included the numbers, configurations, models, locations, initial cost, and utilization of computer systems. Questions remain about the 450 estimate, including the following:

- How was the estimate of programming languages being used in weapon systems derived? These systems were not subject to reporting under the Brooks Act.
- How many of the 450 programming languages were special purpose languages?
- How many of the 450 programming languages were minor dialects of major versions?

The DoD does not maintain "corporate level" information on programming languages used in contemporary software projects. Therefore, gaining a reasonably accurate understanding of programming languages being used in the DoD required input from the organizations responsible for developing or maintaining individual systems. Accordingly, these organizations are the primary source for this survey data.

1.3 Approach

This study began with the identification of data elements needed for an analysis of programming language usage in the development or maintenance of DoD weapon systems and Automated Information Systems (AISs). The 1994 Presidential Budget was used to select a sample of weapon systems to survey. The current DoD list of major AISs was used to select a sample to survey.

Service and DoD program offices provided the data on the programming languages being used to develop or maintain their operational and support software. The primary data reported included the generations and names of the programming languages being used and the amount (source lines) of software written in each programming language expressed as a percentage of the total system. Additional data reported includes the acquisition category and life-cycle phase of the program.

A data collection form was designed to record the data elements identified by the survey respondents. Potential respondents were contacted by telephone to get their agreement to participate in the survey. The data collection form was then faxed to each participant and responses were analyzed to extract the information reported in this study.

1.4 Language Counting Issues

The classification of programming languages for counting purposes has always been, and continues to be, a highly debated subject on which experts differ in definitions and philosophy. Even when definitions are generally agreed upon, the application of the definition in a particular case is often difficult, with results depending on the judgement of a person.

For the purposes of this report, the key issue is the difference between "version" and "dialect." We use the term "dialect" to indicate a relatively minor change in a language whereas "version" indicates a larger change and usually has a different "name" although the new "name" may only be the concatenation of a different year or number to the baseline name (e.g., Jovial, Jovial 73). While these definitions may appear to be abstract issues of interest only to language specialists, they actually have a profound effect on portability, interoperability, and counting. If a dialect (involving small changes) is involved, training and portability may be easier than with a new "version." A dialect would normally not be considered a separate language. A version may or may not be considered a separate language, depending on the purposes of the counting. In this report we counted historical *versions* that divide conveniently between pre- and current version years.

Because the practical usage of programming languages is generally at the third generation level, this survey concentrates on this level while still collecting some minimal data for other generations of languages. Consequently, the results from this survey can be compared only in a general way with the historical assertion about "450" general purpose languages as a practical illustration of what is happening in the DoD environment.

1.5 Scope

The results of this survey are drawn from a limited sample of DoD weapon systems and AISs; therefore, the survey does not provide an exact and detailed record of computer programming language usage in the DoD. Several constraints affected the precision of the results:

- The study's sponsors were primarily interested in knowing the primary languages being used in DoD. A detailed, comprehensive inventory of computer programming language usage in the DoD was not called for. Therefore, the following types of software were partially or wholly excluded from the survey:
  - Software being developed at Service and DoD research laboratories
  - Software being developed for highly classified systems
  - Commercially purchased software
  - Firmware
  - Software funded by Operations and Maintenance (O&M)
  - Software below the funding level for Presidential budget-line identification
- The effort required by respondents to complete the survey form was to be minimized. Therefore, trade-offs were made in the amount and detail of information requested.
- The resources available for the conduct of the survey were limited.

1.6 Organization

A description of the methods used to identify the survey population and sample is found in Section 2. A profile of the survey respondents is presented in Section 3. Analysis of the programming language data obtained by the survey is provided as findings in Section 4. Section 5 summarizes the conclusions drawn from survey results. Section 6 contains the recommendation. Appendix A contains the survey instrument and Appendix B provides the data obtained during the survey. We have provided as much detail as possible about the method and response data with the intent of providing a documented baseline for future language studies.

2. SURVEY METHOD

Several approaches to conducting the survey were initially considered. These approaches are briefly discussed below before describing in detail the selected approach.

A comprehensive DoD data call was considered, involving a formal request for specific data elements throughout the DoD. This approach was rejected because it would have encompassed a great deal of effort on the part of operational organizations whose primary mission is readiness. Historically, the response rate has been low to data calls for information that is not directly related to assigned missions.

Another approach involved reviewing several automated databases that contain programming language information on DoD systems. Several of these databases were examined as part of this study, but none were able to provide the information required. It was also difficult to determine the lineage and accuracy of the data. Therefore, these databases were not used as part of the present study.

The approach that was chosen involved direct contact with the organizations responsible for developing or maintaining systems that contain software. This section provides a detailed description of this approach, including the survey populations and samples, trade-offs made in designing the data collection form, the method used in contacting potential respondents, the methods for handling erroneous response data values, and the methods for analyzing the survey results.

2.1 Population Identification

We recognize that a census population of software would include systems that are new or undergoing major modernization and software in a steady state of maintenance. Software being maintained is a collection of applications that are difficult to identify because they are aggregated under operational costs. After a trial effort, we could see clearly that the estimated time and effort to approximate a census population would exceed the targets agreed for this survey effort. Consequently, we identified a judgement population as described in the next sections.

2.1.1 Weapon Systems Population

Weapon systems include aircraft, ships, tanks, tactical and strategic missiles, smart munitions, space launch and space-based systems, command and control (C2), and command, control, communications (C3), and intelligence (C3I) systems. For the purposes of this survey, weapon system software is considered to comprise embedded, C3, and C3I systems, as well as any other software that directly supports or is critical to a weapon system's mission [STSC 1994].

Four acquisition categories (ACAT) are defined for weapon systems by DoD Instruction 5000.2 [DoDI 1991, pp. 2-2–2-4]:

- *Acquisition Category I* is for major defense acquisition programs with eventual Research, Development, Test and Evaluation (RDT&E) expenditures of more than $300 million and eventual procurement costs of more than $1 billion (in FY90 constant dollars).
- *Acquisition Category II* is for major systems with eventual RDT&E expenditures of more than $115 million and eventual procurement costs of more than $540 million (in FY90 constant dollars).
- *Acquisition Categories III and IV* are for programs not meeting the criteria for ACAT I and II. These programs do not have specific expenditure profiles and exist to allow different levels of reporting.

2.1.2 Automated Information Systems Population

An Automated Information System (AIS) can be functionally described as follows:

> A combination of computer hardware and computer software, data and/or telecommunications, that performs functions such as collecting, processing, transmitting, and displaying information. Excluded are computer resources, both hardware and software, that are: physically part of, dedicated to, or essential in real time to the mission performance of weapon systems; used for weapon system specialized training, simulation, diagnostic test and maintenance, or calibration; or used for research and development of weapon systems. [DoDI 1993]

These systems are often categorized as automatic data processing systems that are designed to meet specific user requirements for business functions (e.g., transaction processing, accounting, statistical analysis, or record keeping) and they are implemented on general purpose computers, including personal computers.

An authoritative source for a complete inventory of existing AISs could not be identified. Given the time and effort constraints placed on this study, the list of 53 designated major AISs was used as the AIS survey population [OASD 1994]. A major AIS is defined as one that is not a highly sensitive, classified program (as determined by the Secretary of Defense), and that according to DoDI 8120.1, the instruction on life cycle management of AISs [DoDI 1993], is characterized by the following:

- Has anticipated program costs, computed in FY 1990 dollars, in excess of $100 million; or
- Has estimated program costs, computed in FY 1990 dollars, in excess of $25 million in any single year; or
- Has estimated life-cycle costs, computed in FY 1990 dollars, in excess of $300 million; or
- Is so designated by the milestone decision authority.

2.2 Sample Selection

The approach used in selecting the sample from the population of weapon systems and AISs is described in the next section.

2.2.1 Weapon Systems Sample

A close approximation of the population of existing weapon systems was found in a commercially available publication [Carroll 1994]. This publication provided a list of over 1,300 RDT&E and procurement programs for all Services and DoD Agencies. The list, called the Program Management Index (PMI), was based on the President's 1994 budget request and identifies all RDT&E programs with current or future fiscal budgets exceeding $15 million and procurement programs with total budgets of more than $25 million.

The PMI contains a number of programs that do not develop or maintain software for a weapon system (e.g., ammunition programs, medical research, biodegradable packaging technology) and lacks some programs that would have been of interest such as intelligence systems, highly classified programs, and programs below the budgetary thresholds cited. The PMI was then reviewed to eliminate programs that were obviously outside of the population of interest. For example, programs such as 25MM Ammunition Development, Health Hazards of Military Material, and Petroleum Distributions were eliminated from the population. Also eliminated were basic and applied research programs that involve technology years away from being fielded. While these programs often involve small amounts of prototype software development, the scope of the survey constrained the size of the survey sample.

Each of the programs remaining in the PMI list was briefly examined to characterize the likelihood of being a weapon system. Weapon systems such as aircraft, ships, and tanks were (usually) easily identifiable. However, many of the programs required additional effort to determine their relevance to the population. For example, the AN/BSY-2 is an RDT&E project. Unless one is familiar with the AN/BSY-2 project, it is not immediately clear that it is the combat system for the Seawolf submarine and contains an aggregate of several million lines of software.

Of the 423 programs selected from the PMI list to form the survey sample, 142 were eliminated from the sample after we found that they had been cancelled or were combined with another program, or contained no software. The remaining 281 programs included most of the typical weapon platforms (e.g., aircraft, ships, submarines, tanks) and many of the sensors, communication systems, and weapon subsystems.

2.2.2 Automated Information Systems Sample

Of the 53 AISs on the original list, 2 have been cancelled, 4 were primarily acquisitions for hardware and commercial off-the-shelf (COTS) software, 5 have not begun to develop software, and 4 programs had no current program manager name and telephone number. The survey sample of AISs for this study, therefore, consists of the remaining 38 major AISs.

2.3 Data Collection Form

A data collection form was designed for this survey to reduce respondent error and to present technically accurate language choices. Because data was to be collected on five different programming language generations, definitions of these language generations were adapted from the ANSI/IEEE Standard Glossary of Software Engineering Terminology [ANSI/IEEE 1990] with advice from Ms. Jean Sammet, language historian. These definitions were provided on the form as follows:

- A *first generation language* is the same as a machine language, usually consisting of patterns of 1's and 0's with no symbolic naming of operations or addresses.
- A *second generation language* is the same as assembly language.

- A *third generation language* is a high order language that requires relatively little knowledge of the computer on which a program will run, can be translated into several different machine languages, allows symbolic naming of operations and addresses, provides features designed to facilitate expression of data structures and program logic, and usually results in several machine instructions for each program statement.
  - A *special purpose language* is used for special-purpose application areas such as robotics, machine tool control, equipment testing, civil engineering, and simulation. Special purpose languages are a subset of third generation languages.
- A *fourth generation language* is designed to improve the productivity achieved by high order (third generation) languages and, often, to make computing power available to non-programmers. Features typically include an integrated database management system, query language facility, report generator, screen definition facilities, graphics generators, decision support capabilities, and statistical analysis functions. Fourth generation languages are usually available as components of a COTS software package.
- A *fifth generation language* incorporates the concepts of knowledge-based systems, expert systems, inference engines, and natural language processing.

Languages were grouped on the data collection form by these generations and listed by name and version within the third generation languages category. We decided not to ask for name and version of first, second, fourth, and fifth generations because supplying that type of data would require an inordinate amount of research effort for respondents to provide and for us to validate.

An overriding concern for the data collection form was to keep it as simple as possible. Data collection forms that are lengthy or require a great deal of effort to complete are less likely to be completed and returned. Thus, the following design decisions were made with respect to the data collection form:

- Survey respondents were allowed to choose the level of abstraction addressed by their response(s). Ideally, we would have liked to obtain a single response covering a single weapon system or AIS. However, many weapon systems are composed of subsystems that are separate procurement programs being developed or maintained concurrently by different contractors. These contractors and their sub-contractors may differ from one another in their choice of programming languages and dialects, depending upon the component(s) being developed or maintained. Because of the likely difficulty in requiring single-system reporting, survey respondents were asked to complete the data collection form at the level of abstraction that was the most convenient for them. Respondents were asked to photocopy the data collection form and return multiple copies if they provided data for more than one system or subsystem.

- Where possible, a list of allowable values was provided so that the respondent could simply place a check mark by the appropriate value. For example, rather than asking the respondent to write the name of the system life-cycle phase, the allowable values were provided on the data collection form. Such lists also reduced the likelihood of obtaining invalid data responses.
- Where practical, ranges were used instead of requesting exact values. Ranges were used for the estimation of total source lines of code (SLOC) and for the amount of software developed or maintained per programming language. The use of ranges reduces the precision of the survey results (e.g., the SLOC totals will be partially based on an estimation procedure). However, the reduction in precision was considered justified in terms of the corresponding decrease in effort for filling out the survey form.
- The temptation to ask for more information than absolutely needed was resisted. A number of interesting data elements were considered for inclusion in the data collection form but rejected because they were not essential and would increase the effort and time needed to complete the form. This concern also led to the decision to ask for the versions of third generation languages only.

The key information desired from each survey respondent included the following items:

- A list of all third generation languages (by version) being used in the development or maintenance of operational and support software for the system of interest.
- For each programming language listed, an estimate of the percentage that language represents in terms of the total amount of software being developed or maintained. We suggested that the percentage be derived from SLOC since most DoD programs track the amount of software using this measure. However,

alternative methods of determining the percentage (e.g., function points) were allowed, as indicated on the questionnaire itself.

- An estimate of the total amount of software being developed or maintained for the program/system. Again, we suggested using SLOC for this estimate.

Secondary information desired from each survey respondent included the following items:

- The amount of first, second, fourth, and fifth generation software being developed or maintained.
- The number of distinct assembly languages being used in system development or maintenance.
- A list of any third generation special purpose languages being used to develop or maintain software (e.g., equipment checkout languages such as ATLAS).
- The acquisition category assigned to the program/system.
- The system life-cycle phase of the program/system.

A pilot survey was conducted using a preliminary version of the data collection form. Improvements were made according to suggestions made by several respondents as well as by analysis of their responses. Appendix A provides a copy of the final data collection form.

2.4 Contact Process

The process for contacting potential survey respondents for weapon systems and AISs differed only in the means by which telephone numbers were obtained. For weapon systems, the PMI list provided the name and telephone number of each weapon system program manager. For AISs, the Office of the Secretary of Defense official responsible for oversight of that AIS was contacted to provide the name and telephone number of the AIS program manager.

The purpose of the survey was described upon contacting each potential respondent. Suggestions for filling out the form were provided and the form was then faxed to the potential respondent. If a response was not received after three weeks, a follow-up call was placed.

2.5 Respondent Errors

Some data collection forms were not completely or accurately filled out by survey respondents. For example, respondents may have omitted the Acquisition Category because it was not known to the respondent or was overlooked. The most common instance of inaccurate responses was that two different programming languages were listed as being used for over 75% of the system. If the correct data was not immediately obvious, the respondent was either contacted for the correct data or the values reported for the data element were excluded from our analysis and logged as a non-response. Graphic displays of survey results in the next section show these errors as "data not available."

2.6 Analysis Process

The process for estimating the total number of SLOC addressed by this survey is now described. As discussed in Section 2.3, respondents were not requested to provide an exact SLOC count for their response. Rather, they were asked to select from a range of "Total Source Lines of Code." A uniform procedure for estimating the SLOC represented by each survey response form was developed. Table 1 provides the Total SLOC ranges on the response form and the corresponding SLOC count assigned to each range. For example, if the "100-500K" range was checked on the response form, 300K was used as the total SLOC covered by the response form. The SLOC sizes in the "Value Assigned" column in Table 1 were subjectively assigned. *However, if an exact SLOC count was provided on the response form, that count was used in place of an estimate.* The total SLOC addressed by this survey was therefore derived by summing the estimated SLOC (or in some cases the exact SLOC) from each response form. Values assigned in Table 1 were subjectively assigned for the top and bottom ranges; the midpoint was used for other ranges.

Table 1. Values Assigned to SLOC Range Estimates

"Total SLOC" Range Marked on Response Form	Value Assigned
1-100K	75K
100-500K	300K
500-1,000K	750K
1,000-5,000K	3,000K
5,000+K	6,000K

Respondents were also requested to provide the percentage of the total system written in each applicable language. Ranges were available to identify this percentage.

Table 2 provides the "% of Total" ranges on the response form and the corresponding percentages assigned to each range. For example, if "5-25%" was checked for Jovial 73, 15% was used as the percentage of the total system written in Jovial 73. *If an exact percentage was provided on the response form, that percentage was used in place of an estimate*. For each response, the SLOC for each language was derived by multiplying the total SLOC count (see Table 1 on page 12) by the estimated percent of total system written in that language.

Table 2. Values Assigned to Language Percentage Estimates

"% of Total" System Marked on Response Form	Value Assigned
<5%	2.5%
5-25%	15.0%
25-50%	37.5%
50-75%	62.5%
>75%	87.5%

The problems in using SLOC as a means of measuring the amount of software are well publicized [Jones 1991]. It is unlikely that respondents would have provided much data had specific methods for counting SLOC been required. Therefore, survey respondents were allowed to provide SLOC range estimates using their method for counting SLOC. Clearly, non-uniform methods for counting SLOC reduces the precision of the SLOC-related portions of the survey. However, this trade-off does not detract from the primary purpose of the survey (i.e., to produce a count of programming languages being used in the DoD today).

3. RESPONDENT AND PROGRAMMATIC PROFILE

Before presenting the survey results, it is important to realize that the level of abstraction of survey responses varies (see Section 2.6 to understand the rationale for this decision). For example, some responses describe an entire weapon system (e.g., the V-22 Osprey), other responses describe different versions of a weapon system (e.g., the Standoff Land Attack Missile (SLAM) Baseline and the SLAM Upgrade), while other responses describe major subsystems resident within a weapon system (e.g., seven subsystems on the C/KC-135). Consequently, there is not a one-to-one mapping between a survey response and a single weapon system. Therefore, survey results are presented in terms of responses, not "programs" or "systems".

The survey data collection form was structured to provide the Service and Agency distribution of respondents as the demographic data of interest to DoD. Attributes being surveyed included the acquisition cost category and the life-cycle phase. This section presents observations from the weapon system and AIS responses.

3.1 Weapon System Responses

The distribution of the weapon system responses in terms of Service participation, acquisition category, and acquisition phase are presented for information purposes only.

3.1.1 Services

Figure 1 presents the distribution of responses by Services. The sample of programs selected was not evenly distributed among Army (19%), Navy (50%), and Air Force (26%); consequently, nearly half of the responses were from the Navy. The "Other" category represents responses from the Ballistic Missile Defense Organization, Defense Logistics Agency, and Defense Information Systems Agency.

3.1.2 Acquisition Category

Figure 2 presents the distribution of acquisition categories for the weapon system responses. The largest percentage of responses were from ACAT I programs, with ACAT III close behind.

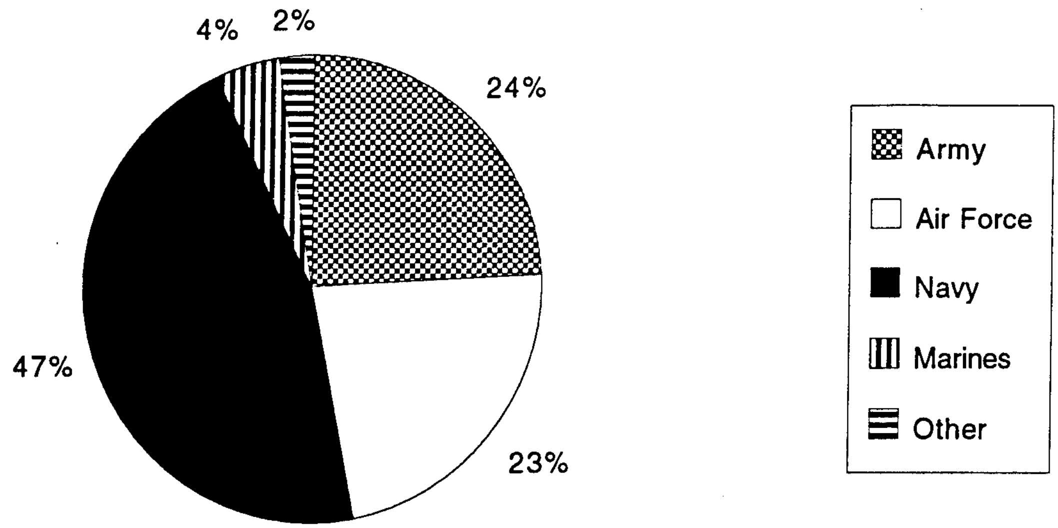

Figure 1. Distribution by Service for Weapon System Responses

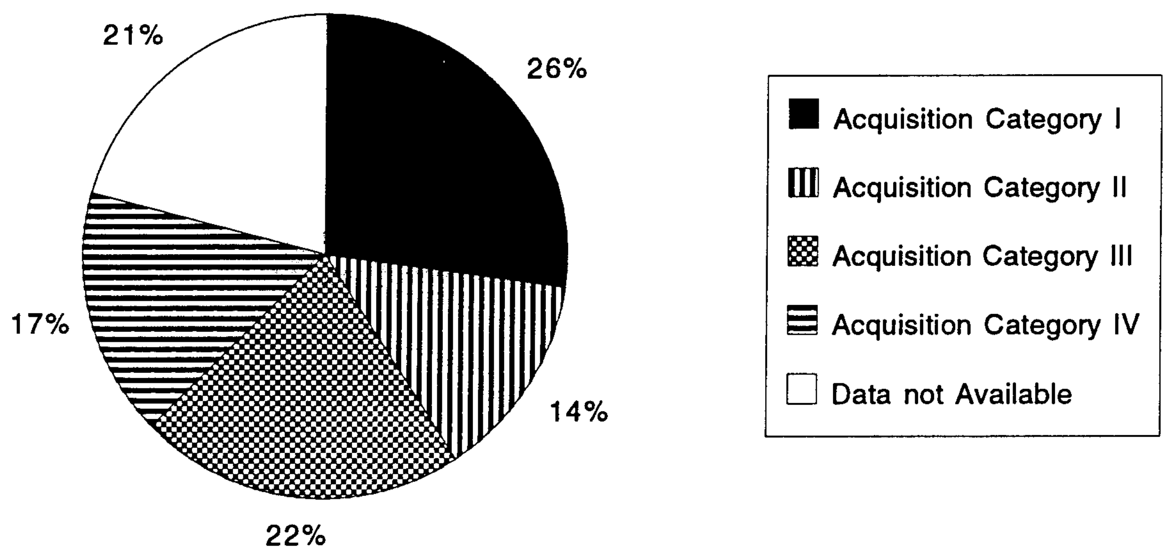

Figure 2. Distribution by Acquisition Category for Weapon System Responses

3.1.3 Acquisition Phase

Figure 3 presents the distribution of acquisition phases for the weapon system responses. The Engineering & Manufacturing Development and Production & Deployment phases combine to represent 79% of the total number of responses.

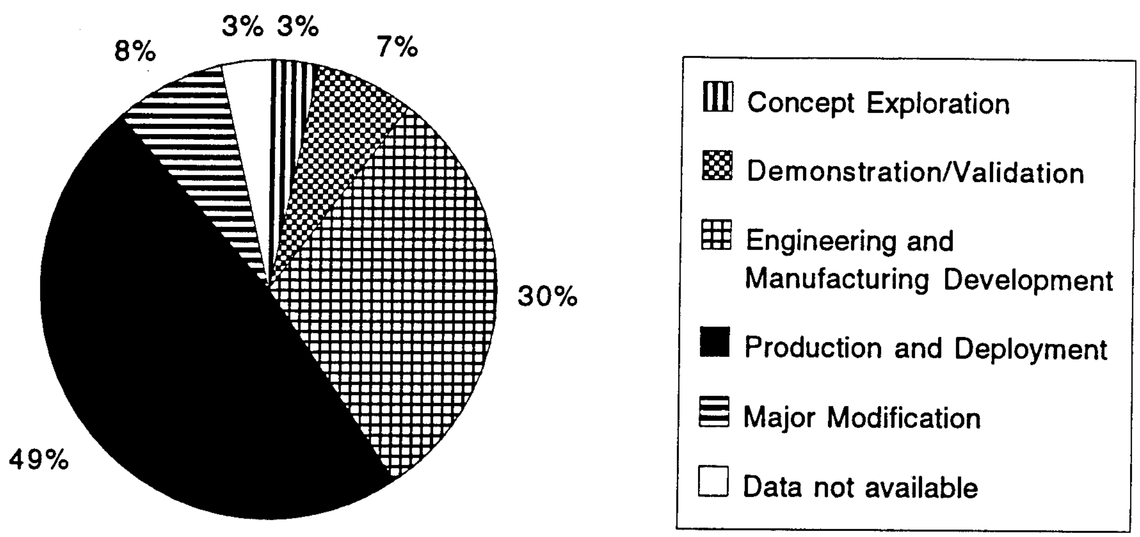

Figure 3. Distribution by Acquisition Phase for Weapon System Responses

3.2 AIS Responses

The distribution of the AIS responses in terms of Service participation and acquisition phase are presented for information purposes only. Acquisition category is not defined by the same rules as for weapon systems. The data collected from the survey forms has been omitted here because it was considered unreliable (e.g., over half of the respondents did not report acquisition cost category).

3.2.1 Services

Figure 4 presents the distribution of Services contributing to the major AIS survey. The "Other" category includes the Defense Information Systems Agency and Defense Logistics Agency. There were no Marine Corps AISs in the survey samples.

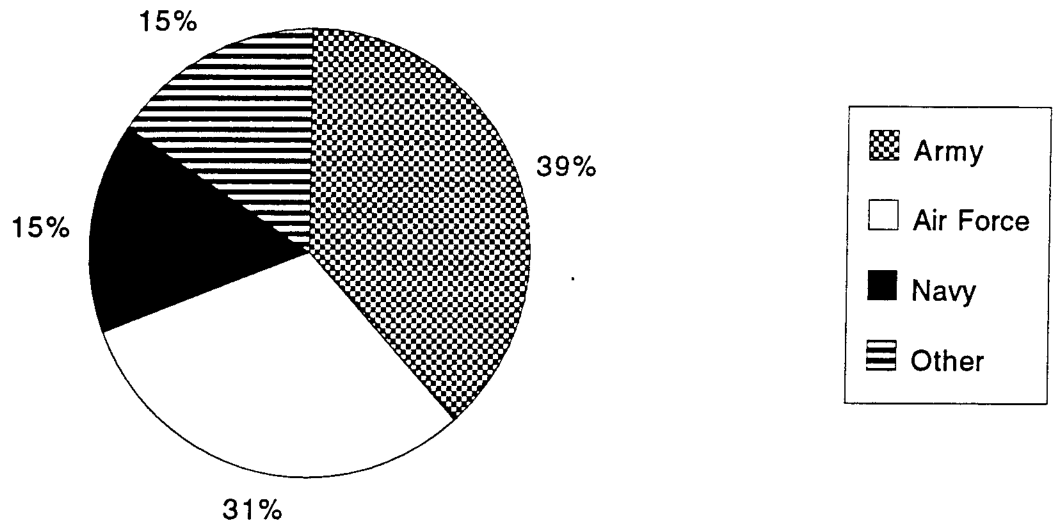

Figure 4. Distribution by Service for AIS Responses

3.2.2 Acquisition (Life-Cycle) Phase

Life-cycle phases for AISs are defined by DoDI Instruction 8120.1 [DoDI 1993]. Figure 5 presents the distribution of life-cycle phases reported by the major AISs surveyed.

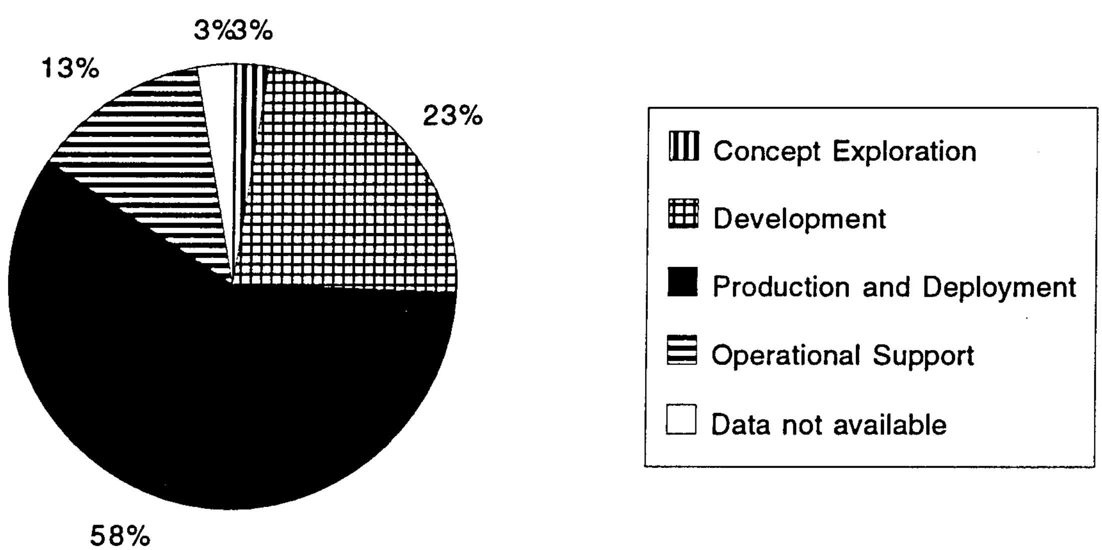

Figure 5. Distribution by Acquisition Phase for AIS Responses

4. LANGUAGE USAGE FINDINGS

4.1 Weapon System Findings

Finding 1: Most weapon system software is being written and maintained in (general and special purpose) third generation languages.

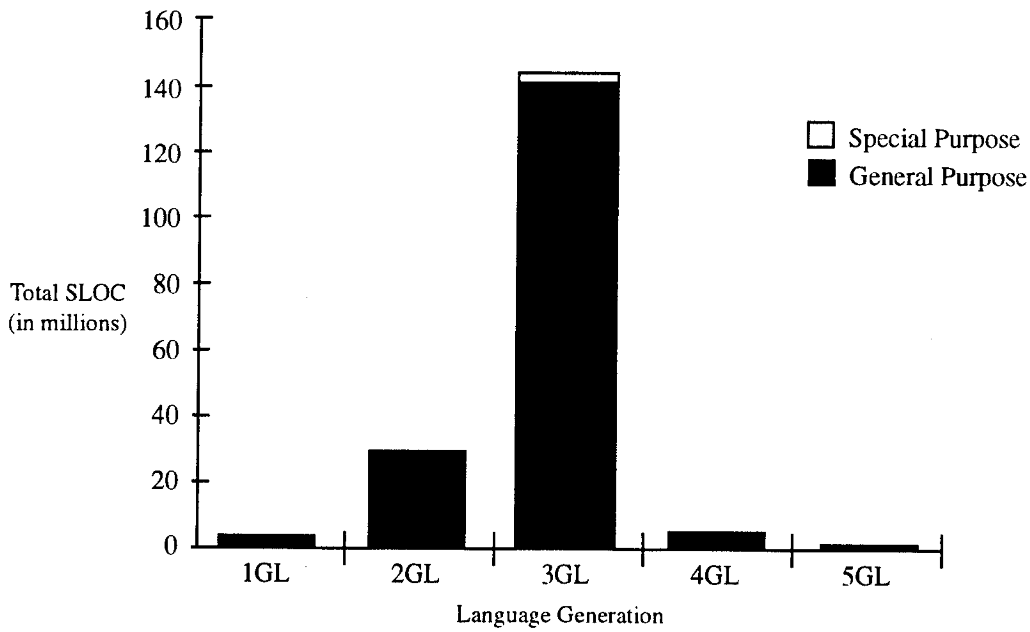

Figure 6. Total SLOC by Language Generation for Weapon System Responses

More than 150 million SLOC (i.e., 81%) of the weapon system software surveyed is written in third generation languages. Without historical data similar to Figure 6, trends such as the changing emphasis on particular language generations cannot be adequately identified. However, it is very likely that over the past 20 years there has been a gradual decline in the use of machine and assembly languages and a corresponding increase in third generation languages.

Table 3 on page 20 provides a numerical presentation of the same data as Figure 6. Table 4 lists the estimated total surveyed SLOC for each third generation language. The

Total SLOC Reported column in Table 3 and Table 4 has been rounded to the nearest million.

Table 3. Total SLOC by Language Generation for Weapon System Responses

Language Generation		Total SLOC Reported (in millions)
First		3.90
Second		26.30
Third	General Purpose	148.38
Third	Special Purpose	3.70
Fourth		5.00
Fifth		0.29

Table 4. Total SLOC by General Purpose 3GL for Weapon System Responses

Third Generation Language and Version	Total SLOC Reported (in millions)
Ada 83	49.70
C 89	32.50
Fortran pre-91/92	18.55
CMS-2 Y	14.32
Jovial 73	12.68
C++	5.15
CMS-2 M	4.23
Other 3GLs	3.38
Pascal pre-90	3.62
Jovial pre-J73	1.12
Fortran 91/92	1.00
PL/I 87/93 subset	0.64
Basic 87/93 (full)	0.48
PL/I 76/87/93	0.36
Pascal 90 (extended)	0.29
Basic 78 (minimal)	0.17
LISP	0.10
Cobol pre-85	0.09
Cobol 85	0.00
Total	**148.38**

The following special purpose third generation languages were also reported (Table 5).

Table 5. Third Generation Special Purpose Languages

Language	Purpose	SLOC
ATLAS	Equipment Checkout	1.38
VHDL	Hardware Description	0.18
CDL	Hardware Description	0.22
GPSS	Simulation	0.04
Simulink	Simulation	0.06
CSSL	Simulation	0.01
ADSIM	Simulation	0.02
SPL/1	Signal Processing	1.62
SPL	Space Programming	0.01

Respondents were provided space on the data collection form to identify any programming languages being used that were not already listed. These languages formed the "Other 3GLs" noted in Table 4 on page 20, and included the languages listed in Table 5 and Table 6.

Table 6. Third Generation "Other" Languages

Language	Purpose Unverified
DTC	
LISA	Language for Systolic Array Processor
PIL	HARM Program Implementation Language
PLM	
PLM-51	
PLM-86	
Pspice	
REXX HOL	
TACL TSC	
VTL	

Finding 2: Ada is the leading third generation language in terms of existing weapon system source lines of code.

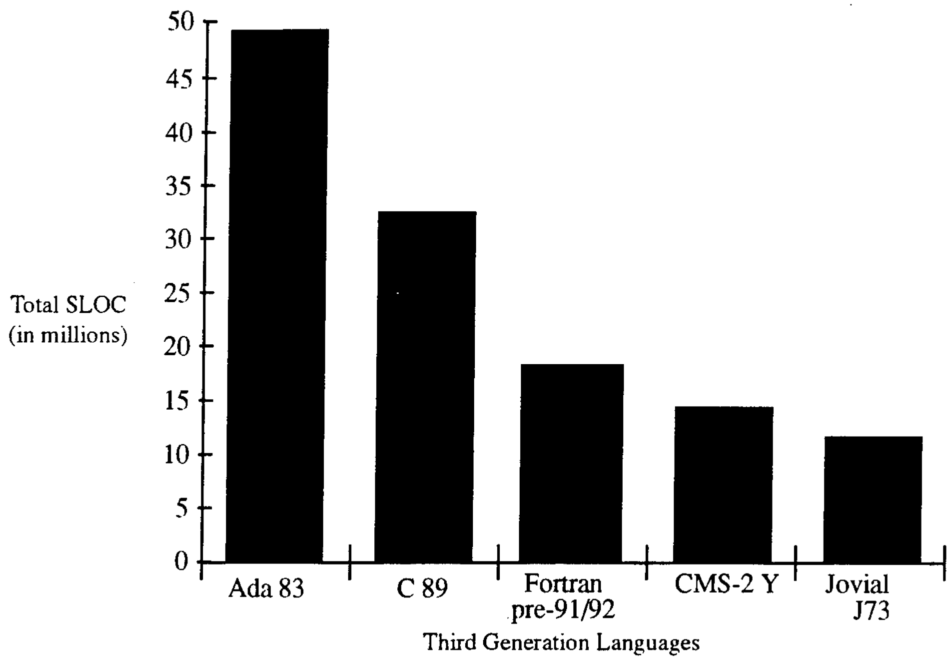

Figure 7. Top Five 3GLs by Total SLOC for Weapon System Responses

Figure 7 presents the top five third generation languages in terms of estimated total SLOC surveyed. Survey responses reported an estimated 49+ million SLOC in Ada and 32+ million SLOC in C. These five languages represent about 84% of the total estimated third generation SLOC reported.

Finding 3: Ada is the leading third generation language in terms of number of weapon system responses indicating usage.

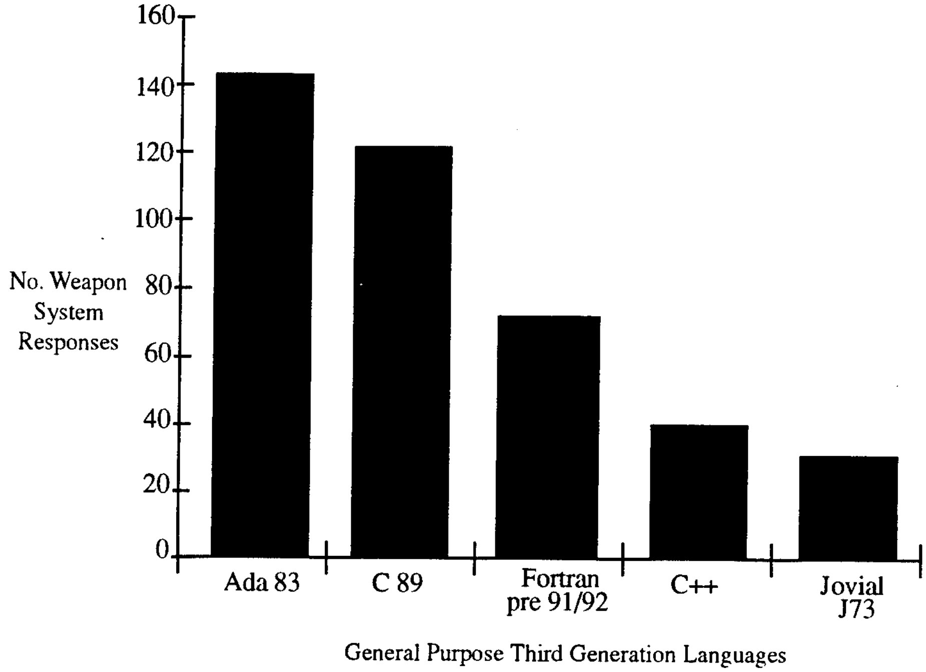

Figure 8. Top Five 3GLs by Reported Usage for Weapon System Responses

Figure 8 presents the top five third generation languages in terms of the number of responses reporting specific language use. As can be seen, 143 responses indicated the use of Ada and 122 responses indicated the use of C. In comparing Figure 7 and Figure 8, the key difference is the more frequent reported use of C++, albeit with fewer total estimated surveyed SLOC. Note that the data presented in Figure 7 do not represent a uniform population (i.e., survey responses address varying levels of abstraction). See Section 2.6 for details.

Finding 4: Two-thirds of the weapon system responses reported on application systems of 500,000 or less SLOC.

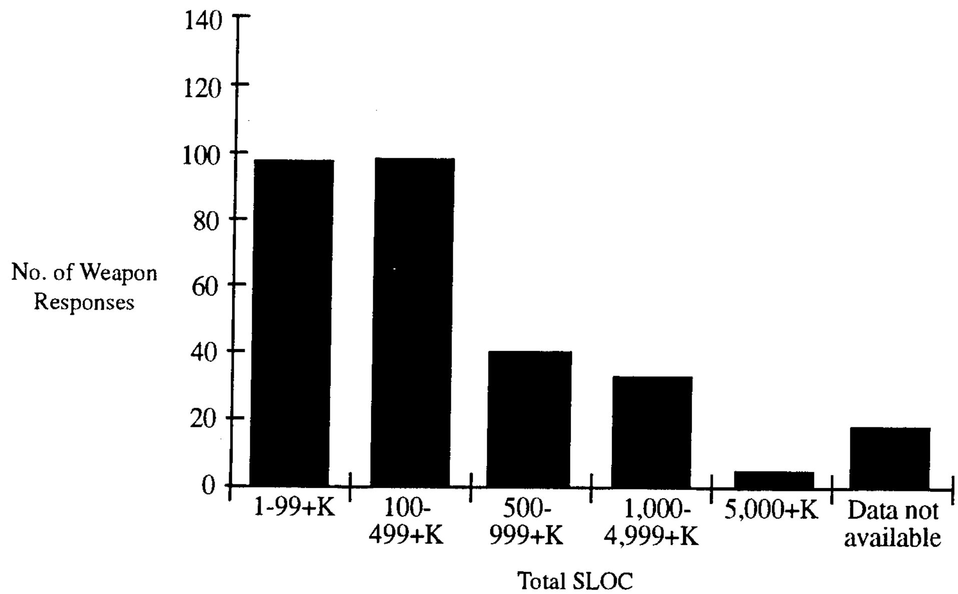

Figure 9. Distribution of Total SLOC Size for Weapon System Responses

Figure 9 presents the distribution of responses in terms of the Total SLOC range selected on the response form. The large number of 1-499+K responses is due, in part, to responses at the subsystem level.

Finding 5: Over 70% of the weapon system responses indicated the use of more than one programming language from all five generations.

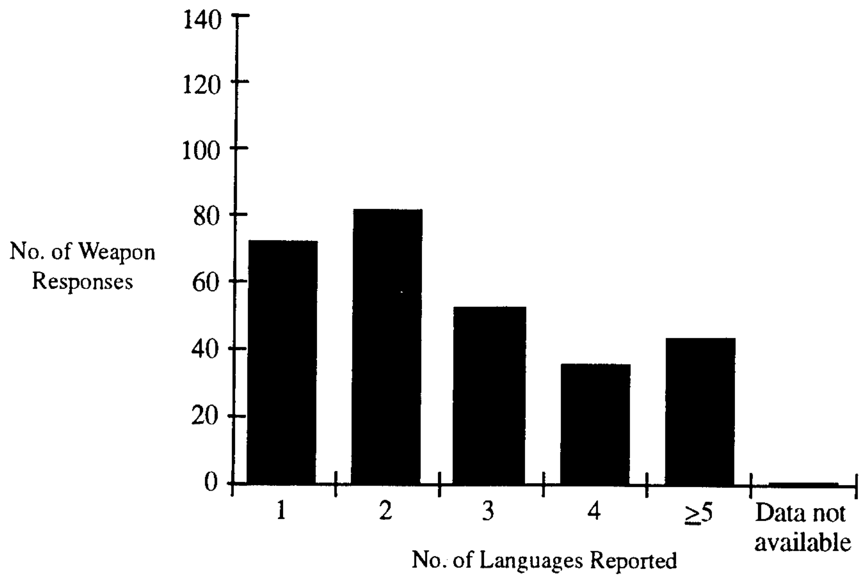

Figure 10. Distribution of Number of Languages Reported by Weapon System Responses

Figure 10 presents the distribution of responses in terms of the number of languages reported on a response form (single subsystem or system).

Finding 6: Multiple versions of third generation languages are being used in weapon systems.

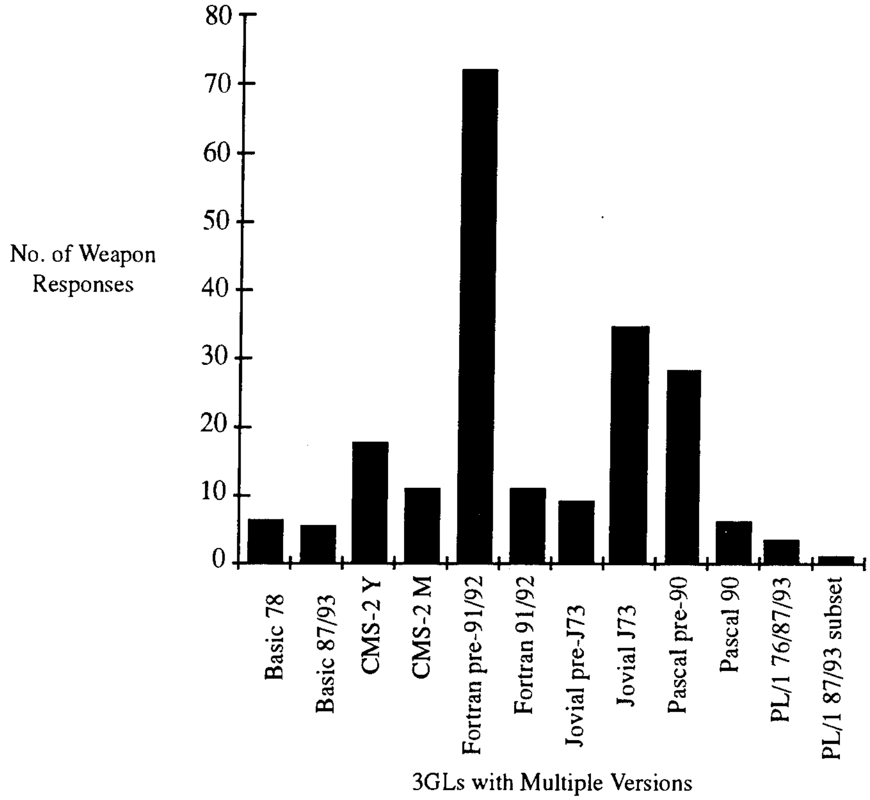

Figure 11. Comparison of 3GLs with Multiple Versions for Weapon System Responses

The goal of the 1970s, language commonality within the weapon system community, has not been reached yet even for military standards such as Jovial and CMS-2 (Figure 11). In addition, at least two versions are being used for most Federal Information Processing Standards (FIPS). Different versions of a language are almost always incompatible. Dialects of a version present subtle but not inconsequential porting problems, particularly when they are dialects based upon older versions of the language. For example, there are 10 or more different dialects of pre-J73 Jovial still in use.

4.2 AIS Findings

Finding 7: Most AIS software is being written and maintained in third generation languages.

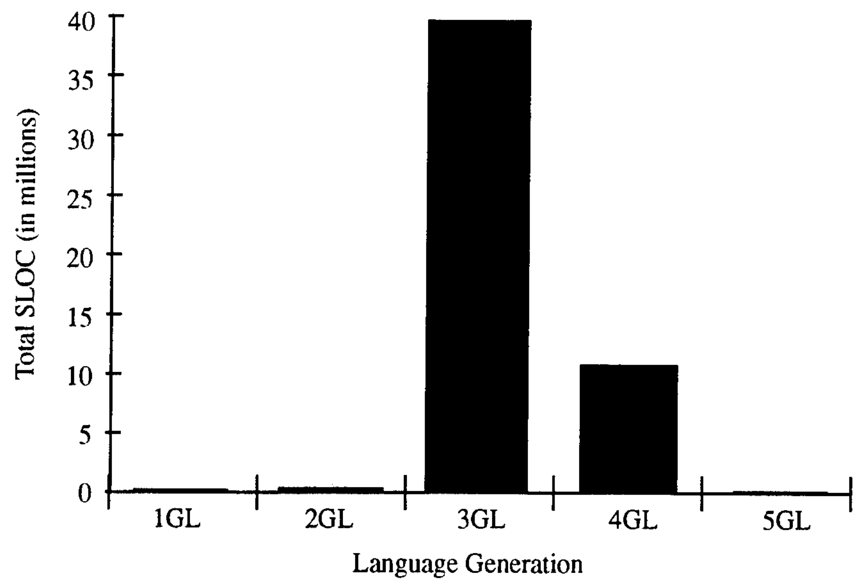

Figure 12. Total SLOC by Language Generation for AIS Responses

Figure 12 is the SLOC distribution of all generations of languages used in AIS application. Table 7 is the numeric presentation of Figure 12. The use of first generation language (machine language) is limited to only one of the AISs. The use of assembly (including proprietary macro languages) is inconsequential when compared to weapon system applications.

Table 7. Total SLOC by Language Generation for AISs

Language Generation		Total SLOC Reported (in millions)
First		0.30
Second		0.63
Third	General Purpose	38.24
	Special Purpose	0.00
Fourth		10.81
Fifth		0.05

Table 8 is the SLOC estimates in millions for third generation languages.

Table 8. Total SLOC by 3GL for AISs

Third Generation Language / Version	Total SLOC Reported (in millions)
Cobol 85	14.06
Cobol pre-85	8.59
Ada 83	8.47
Basic 87/93	2.18
C++	2.05
C 89	1.55
Fortran 91/92	0.87
Fortran pre-91/92	0.47
Total	**38.24**

Finding 8: Cobol is the leading third generation language in terms of existing AIS source lines of code.

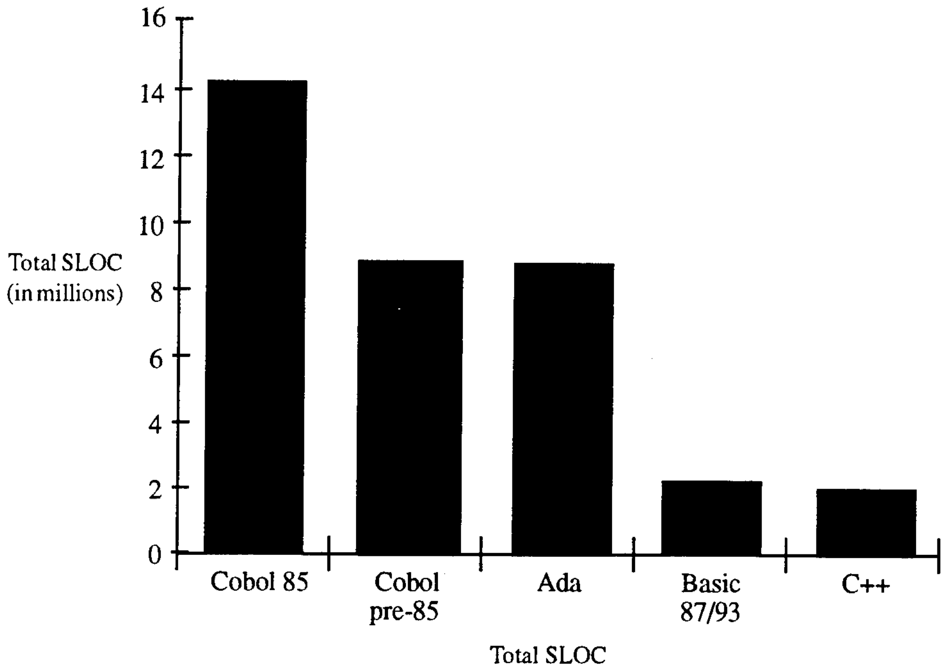

Figure 13. Top Five 3GLs by Total SLOC for AIS Responses

Figure 13 presents the top five third generation languages in terms of estimated total SLOC reported. Survey responses reported an estimated 22 million SLOC in two versions of Cobol and about 8 million SLOC in Ada. These five languages represent about 89% of the total estimated third generation SLOC reported.

Finding 9: Ada is the leading third generation language in terms of number of AIS responses indicating usage.

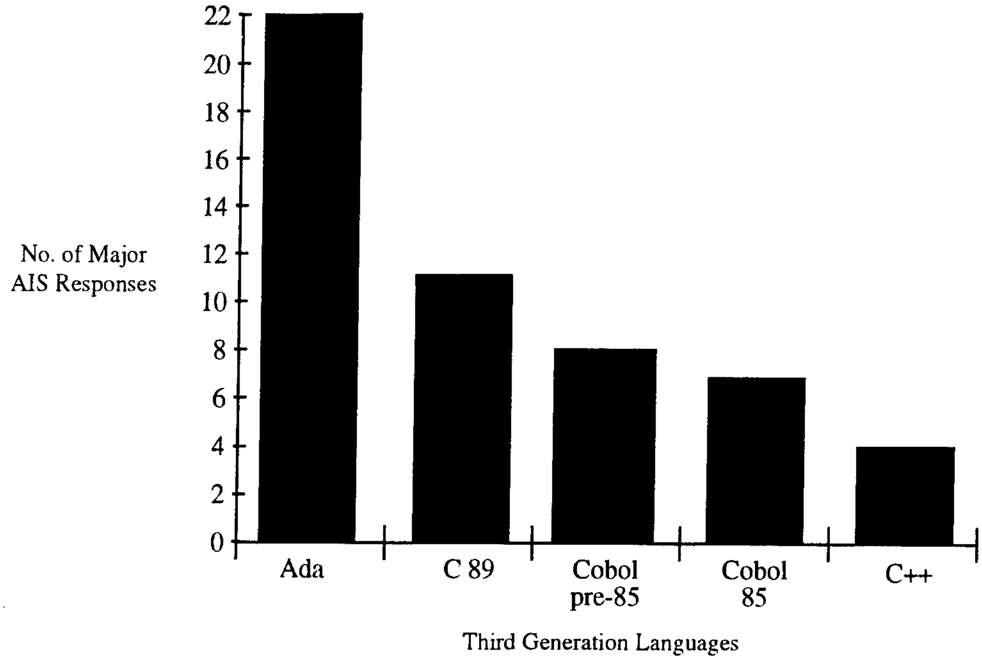

Figure 14. Top Five 3GLs Reported by AIS Responses

Figure 14 shows that the use of Ada was reported by more respondents, although the number of lines of source code written in Ada is less than for Cobol.

Finding 10: Most of the AIS responses reported on application systems are in the range of 100K-5,000K SLOC.

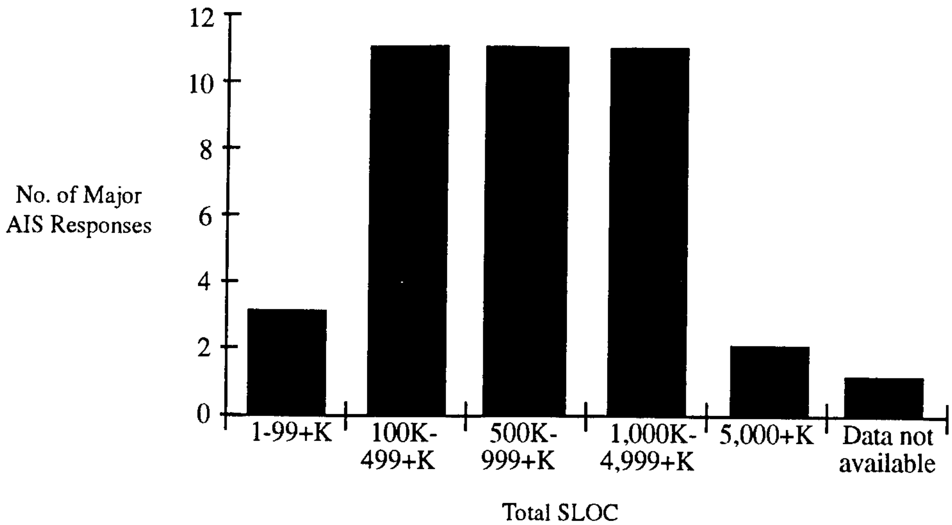

Figure 15. Distribution of Total SLOC Size for AIS Responses

Figure 15 depicts that 85% of the responses are evenly distributed in the mid-size range of applications.

Finding 11: Ninety percent of the AISs surveyed indicated the use of one or more third generation programming languages.

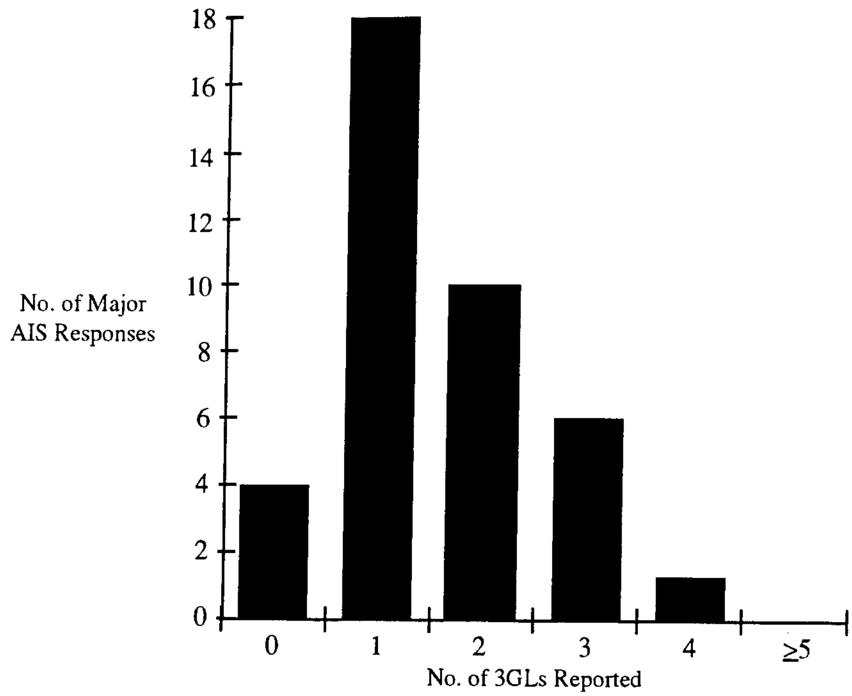

Figure 16. Distribution of Number of 3GLs Reported by AIS Responses

The first column in Figure 16 showing no use of third generation languages indicates that some applications are developed only with fourth generation languages. Fourth generation languages for such applications as database query, report writing, and screens are not applicable to weapon system applications except in the support activities required to construct or maintain applications.

Finding 12: Multiple versions of third generation languages are being used in AISs.

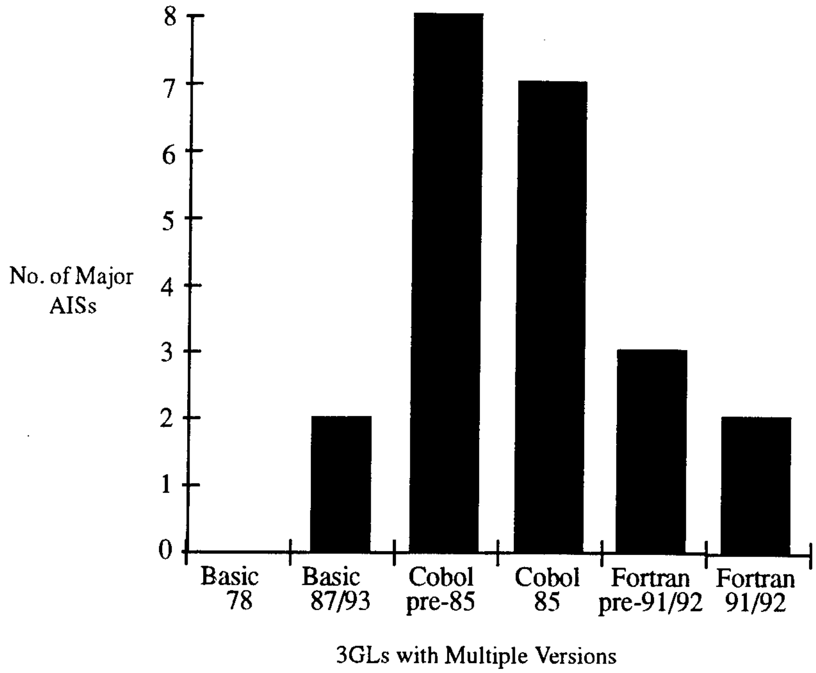

Figure 17. Comparison of 3GLs with Multiple Versions for AIS Responses

Figure 17 indicates that Cobol 85, the current FIPS version, has not had a significant effect on AIS applications, and that older versions of Fortran exceed the number of applications written in the current version.

5. CONCLUSIONS AND DISCUSSION

This survey is not a universal census of weapon systems and AISs but the results reported do represent a substantial and visible portion of the population. Even though the sample size was constrained by available time and resources, a systematic method was used and documented so that others who care to extend the sample size at a later date will be able to obtain results that are consistent with the language counting method used in this survey. The responses received represent over 60% of the programs contacted. We have drawn the following conclusions about programming languages currently used in the DoD, based upon findings from the survey:

Conclusion 1: *The estimated 237.6 million SLOC in this survey are distributed among the five generations of programming languages currently used. The largest and most significant group of programming languages in SLOC is third generation languages which consist of 37 languages. In this group, there are 18 general purpose languages (including separate counts for differing versions of major languages as shown on the survey form), 9 special purpose languages (a subset of third generation languages), and 10 unclassified languages.*

The issue of how to count languages makes this conclusion open to some level of debate. There are many dialects of a language version that some may choose to count as unique languages. If we accept the historical assertion that at least 450 third generation languages were used in the late 1970s, we can see that considerable progress has been made toward reducing the number of programming languages used in DoD.

Conclusion 2: *Ada 83 is being used in weapon system software and AISs that are being modernized. Using SLOC as a measure of usage, Ada ranks first (ref.*

Table 4 on page 20) in weapon systems. In AISs, Ada 83 has not replaced Cobol (ref. Table 8 on page 28).

The fact that Ada usage is not greater in DoD could be due to several factors. First, production quality Ada compilers and development tools were not available immediately after the language was adopted as a standard. There was a lag-time of four to five years before compiler vendors could offer choices of Ada environments for high performance host/target machines. Second, there is always inertia to overcome before change can occur and the resistance of the DoD software development community to DoD policy toward the use of Ada perpetuated that inertia. And third, it takes time to educate and train software engineers and managers to understand the language and to use it effectively.

There is an unknown quantity of legacy software being maintained by software support activities that modify code and/or provide data processing service. Many of these software applications were developed by contractors and are being maintained by the government using the language versions and dialects chosen by the development contractor. The constraints on this survey precluded our being able to systematically collect a sample from the software maintained by O&M budgets. However, we speculate that languages used in the maintenance community include more use of second generation languages (assembly) and older versions of third generation languages.

Conclusion 3: *The usage of first generation language (machine) in both weapon systems and AIS applications is insignificant (ref. Table 3 on page 20).*

The existence of first generation language (machine) is almost certainly due to the continued maintenance of fairly old legacy hardware and software. It is highly unlikely that future new software will be written in first generation languages, considering the target computer systems which will be candidates for modernization.

Conclusion 4: *Second generation language (assembly) is being used in both weapon systems and AIS applications and will likely continue in minimal use.*

To some extent, the use of second generation languages (assembly) is also due to the continued maintenance of legacy software. However, there are specific reasons, other than historical ones, that have necessitated the use of second generation languages. One of these reasons is special purpose hardware and, in this case, the need for second generation languages will almost certainly continue. Another reason is performance. Ten or more years ago, many systems used second instead of third generation languages for those parts of the system that were time critical. Although the performance of modern third generation languages, such as Ada or C, can meet many such performance issues now, it is likely that minimal use of assembly language will continue for some time for its real or perceived performance properties. However, this will become less of a problem as better software engineering techniques are used in code generation.

Conclusion 5: *The use of fourth generation languages is greater in AIS applications than in weapon system applications.*

AIS applications have used fourth generation languages as database management products, graphical user interfaces, and shrink-wrapped tools have been acquired to improve user services. The SQL standard has not only promoted relational database products but has provided an alternative to the continued use of proprietary languages for data access. The modest use of fourth generation languages by the weapon system community could indicate that COTS products are seldom used to develop software or that the respondents did not consider the development environment as appropriate for this survey.

Conclusion 6: *Fifth generation (artificial intelligence) languages are hardly used in weapon system and AIS applications.*

There are several reasons for the very low usage of fifth generation languages. One reason is that the immaturity of fifth generation AI languages does not recommend their use in operational weapon systems. Other reasons could be the lack of exploratory R&D programs in the sample or that many AI problems are being solved with third generation languages.

Conclusion 7: *In both weapons system and AIS applications, the data shows that older versions of programming languages are being used. The perpetuation of applications written in these older versions can create portability and re-use problems.*

For example, the continued use of several versions of CMS2, Jovial, Fortran, Cobol, and platform/vendor unique languages may be motivated by short-term economic views. There are tools to aid in re-engineering and conversion tools that makes reimplementing existing software more feasible and practical than to continue maintenance of this multi-version software.

Conclusion 8: *Both weapon system and AIS applications use several languages.*

Even if only one language were used, software commonality, portability, and interoperability would be imperfect. With modern programming languages and compilers, increased use of COTS products and re-use of software components, it is possible to produce applications with components written in different languages. Ada, with its specified pragma interfaces, is a language that is well suited to being used with other languages in multi-language applications.

6. RECOMMENDATION

Accepting the number of 450 or more general purpose programming languages in use in the 1970s, we can see considerable progress has been made by the Military Departments and Agencies in reducing the number to 37 in major systems that are new or being modernized. Yet the survey indicates that a substantial legacy of applications remain that use older versions of programming languages, vendor-unique languages, and military-defined languages. The maintenance costs for these applications could be reduced and their reliability increased by converting these applications to a current version of a Federal Information Processing Standard language. Automated conversion methods should offer a cost-effective technology to facilitate this conversion. Re-engineering these applications in another language is also a cost reduction opportunity. Redundant code can be eliminated, software components can be re-used, and modern off-the-shelf programming tools can be used to improve maintainability and reliability.

Consequently, we recommend that Service and Defense Agency Program Managers regularly review their software applications to identify a migration strategy and plan for upgrading them to current versions of standards-based versions of languages and modern labor-saving tools. The progress in reducing the number of languages used, as shown in this survey, indicates that further reduction should be possible. Indeed, we recognize that several migration efforts are already ongoing now.

APPENDIX A. SURVEY INSTRUMENT

The data collection form used in the survey is provided in the pages that follow. Two minor changes to the "System Life-Cycle" portion of the data collection form were made to tailor it for the AIS survey: 1) Engineering and Manufacturing Development was replaced by Development, and 2) Major Modification was replaced by Operations and Support.

Language Survey

1. Name of Program: ______________________________

2. System Name (if different than above): ________________

3. Acquisition Category: I: ___, II: ___, III: ___, IV: ___

4. System Life-Cycle Phase:

Concept Exploration:	___
Demonstration/Validation:	___
Engineering and Manufacturing Development:	___
Production and Deployment:	___
Major Modification:	___

5. Total Current Source Lines of Code:

1,000 – 99,999:	___
100,000 – 499,999:	___
500,000 – 999,999:	___
1,000,000 – 4,999,999:	___
5,000,000+:	___

Please complete the remaining portion of the form by indicating the programming languages **currently** being used in developing or maintaining **all** the software (e.g., operational, support) for this program/project.

- For each language being used, estimate the amount of usage in the appropriate "% of Total" column. Most programs should use percentage of source lines of code compared to the total number of source lines of code. However, if your program uses a different method for this calculation (e.g., function points), use this percentage and make a note on page 4.
- Most languages identified on page 2 have a year designation that refers to a specific language version. If you are unable to identify the specific version, please provide supportive information on page 4.
- For second generation (assembly) languages, we are asking for a count of distinct versions being used. The "% of Total" column should be filled out for the aggregate of all assembly languages being used on your program.
- Definitions for language generations are found on page 3.
- If your language version is not listed, identify the version in the space provided on page 4. Provide any comments or additional information on page 4.

Language Type	Language Name and Version		% of Total				
			<5%	5-25%	25 - 50%	50 - 75%	>75%
First Generation	Machine						
Second Generation	Assembly **(Provide Count of Distinct Versions Being Used):** ___________						
Third Generation	Ada 83						
	ALGOL	ALGOL 60					
		ALGOL 68					
	APL 89						
	BASIC	BASIC 78 (minimal)					
		BASIC 87/93 (full)					
	C 89						
	C++ **(identify version on page 4)**						
	CHILL 89						
	COBOL	COBOL pre-85					
		COBOL 85					
	CMS-2	CMS-2 Y					
		CMS-2 M					
	FORTRAN	FORTRAN pre-91/92					
		FORTRAN 91/92					
	JOVIAL	JOVIAL pre-J73					
		JOVIAL J73					
	LISP **(identify version on page 4)**						
	MUMPS	MUMPS pre-90					
		MUMPS 90					
	Pascal	Pascal pre-90					
		Pascal 90 (extended)					
	PL/I	PL/I 76/87/93					
		PL/I 87/93 subset					
	PROLOG **(identify version on page 4)**						
	SIMULA	SIMULA pre-67					
		SIMULA 67					
	Smalltalk **(identify version on page 4)**						
	TACPOL						
	Others: list and identify on page 4						
Fourth Generation	e.g., SQL, RPG, Clipper, Visual BASIC						
Fifth Generation	e.g., Knowledge/rule base shells						

Special Purpose Languages

Application Area	Generic Language Name	Version Name and/or Number	% of Total				
			<5%	5 - 25%	25 - 50%	50 - 75%	>75%
Equipment Checkout	ATLAS						
Hardware Description	VHDL						
	CDL						
Simulation	GPSS						
	SIMSCRIPT						
	CSSL						
Signal Processing	SPL/1						
Space Programming	SPL						
Statistics	SPSS						
	SAS						
Robotics Languages	AL						
	AML						
	KAREL						
Expert System Languages	KRL						
	OPS5						

The following definitions are provided for language generation:

- A *first generation language* is the same as a machine language, usually consisting of patterns of 1's and 0's with no symbolic naming of operations or addresses.
- A *second generation language* is the same as assembly language.
- A *third generation language* is a high order language that requires relatively little knowledge of the computer on which a program will run, can be translated into several different machine languages, allows symbolic naming of operations and addresses, provides features designed to facilitate expression of data structures and program logic, and usually results in several machine instructions for each program statement.
- A *special purpose language* is used for special-purpose application areas such as robotics, machine tool control, equipment testing, civil engineering, and simulation. Problem-oriented languages are a subset of third generation languages.
- A *fourth generation language* is designed to improve the productivity achieved by high order (third generation) languages and, often, to make computing power available to non-programmers. Features typically include an integrated database management system, query language facility, report generator, screen definition facilities, graphics generators, decision support capabilities, and statistical analysis functions. Usually available as components of a commercial off-the-shelf software package.
- A *fifth generation language* incorporates the concepts of knowledge-based systems, expert systems, inference engines, and natural language processing.

Please provide the language name, version, generation, application area (for special purpose languages) and a reference to the manual (i.e., title, date and publisher) for each programming language or version not listed on page 2 or 3. Provide any additional information that would prove useful in uniquely identifying the language.

Language Name, Version, etc.	Manual Title, Date, and Publisher

Additional Comments

APPENDIX B. SURVEY DATA

This appendix provides the raw data collected during the survey. In order to provide respondent anonymity, the program/system names (Section B.1) have been separated from the remaining portion (Section B.2) of the survey data. A single dash (–) in a table cell is used to denote data elements that were not provided on the response form. Each row has been sequentially numbered in order to facilitate identification of specific rows.

B.1 List of Surveyed Program/System Names

This section lists the "Program Name" and "System Name" taken verbatim from each survey response form. Section B.1.1 is the list of program/system names for the weapon system responses. Section B.1.2 is the list of program/system names for the AIS responses.

B.1.1 List of Weapon Program/System Names

Table B-1. Weapon Program/System Names

No.	Program Name	System Name
1	A-10 Thunderbolt II Modification	AFMSS
2	A-10 Thunderbolt II Modification	CDU
3	A-10 Thunderbolt II Modification	LASTE
4	A-10 Thunderbolt II Modification	OTS
5	A/A47U-4A Reeling Machine Launcher	Navy Standard Tow Target System
6	AC-130U Gunship	–
7	AEGIS Simulation Program (ACSIS)	Current
8	AEGIS Weapon System	BL 1 (1983)
9	AEGIS Weapon System	BNI60III
10	AGM-130 Powered GBU-15	AFMSS Weapons Planning Module (WPM)
11	AGM-130 Powered GBU-15	Automatic Pilot Computer Program
12	AGM-130 Powered GBU-15	Horizontal Attack and Envelope Expansion
13	AGM-130 Powered GBU-15	Improved Modular Infrared Seeker Producibility Program
14	AGM-130 Powered GBU-15	MSS II/A Mission Planning Module (MPM)
15	AGM-130 Powered GBU-15	WPM Weapons Simulation Module
16	AGM-65H	TV Maverick R&M 2000 Program
17	AGM-88A High Speed Anti-Radiation Missile (HARM)	–
18	AH-1W Cobra Helicopter	–
19	AH-64 Apache Attack Helicopter	–
20	AH-64A Apache	–
21	AN/ALE-47 Countermeasures Dispenser System	–
22	AN/BSY-2 Submarine Combat System	–
23	AN/SLQ-32(V) Electronic Warfare System	–
24	AN/SSQ-53E Sonobuoy	–
25	AN/TPS-59 TMD MOD KIT Upgrade	–
26	AN/UDR13 Pocket Radiac	–

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
27	AOE6	Machinery Centralized Control System (MCCS)
28	AOE6	SIM/STIM System
29	AQM-37C Aerial Target	–
30	ATCCS Common Hardware/Software (CHS)	–
31	AV-8B	AV-8B Muxbus Data System (AMDS)
32	AV-8B	Day Attack Mission Computer
33	AV-8B	Night Attack Mission Computer
34	AV-8B	Radar Mission Computer
35	AWIS Project Management Office	–
36	Advanced Airborne Radiac System	AARS for OH58D-KW Aircraft
37	Advanced Amphibious Assault Vehicle (AAV)	–
38	Advanced Cruise Missile (ACM)	–
39	Advanced Deployable System (ADS)	–
40	Advanced Field Artillery System (AFAS)	–
41	Advanced Field Artillery Tactical Data System (AFATDS)	–
42	Advanced Spacecraft Technology Integration	High Altitude Balloon Experiment (HABE)
43	Advanced Spacecraft Technology Integration	Liquid Metal Thermal Experiment (LMTE)
44	Advanced Spacecraft Technology Integration	Technology for Autonomous Operational Survivability (TAOS)
45	Advanced Tactical Air Command/Control Center (ATACC)	–
46	Advanced Tank Armament System (ATAS)	–
47	Advanced Training System (ATS)	–
48	Air Defense Missile Systems	Air Defense Communications Platform
49	Air Defense Missile Systems	TAOM
50	Air Traffic Control (ATC) Improvements	DoD Common Console (DDC)
51	Airborne Low Frequency Sonar (ALFS)	–
52	Airborne Surveillance Testbed (AST)	–
53	All Source Analysis System (ASAS)	Block I
54	Armored Gun System	–
55	Armored Systems Modernization	Abrams MIA2
56	Armored Systems Modernization	Advanced Tank Armament System (ATAS)
57	Armored Systems Modernization	Wide Area Munition (WAM)

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
58	Armored Systems Modernization	Airborne Standoff Minefield Detection System (ASTAMIDS)
59	Army Tactical Missile System (ATACMS)	BAT
60	Army Tactical Missile System (ATACMS)	Block I
61	Army Tactical Missile System (ATACMS)	Block IA
62	Army Tactical Missile System (ATACMS)	Block II with BAT
63	Avenger System	–
64	B-1B Modification	Conventional Mission Upgrade program (CMUP)
65	B-1B Weapon System Trainer	–
66	B-52 Stratofortress Modifications	Block II
67	B-52 Stratofortress Modifications	ICSMS
68	BGM-74 Aerial Target	–
69	Brilliant Eyes (BE) Space-Based Sensors	–
70	C-141	Aircrew Training System
71	C-17	Maintenance Training Devices
72	C/KC-135	Air Data Computer
73	C/KC-135	Autopilot
74	C/KC-135	Carousel IV Inertial Navigation System
75	C/KC-135	Digital Engine Pressure Ratio Transfer
76	C/KC-135	Fuel Savings Advisory System
77	C/KC-135	Fuel System Advisory
78	C/KC-135	Standard Flight Data Recorder
79	CV HELO Avionics	SH-60F/HH-60H
80	Carrier Air Traffic Control	AN/SPN-42
81	Carrier Air Traffic Control	AN/SPN-46
82	Cheyenne Mountain Complex	Command Center Processing and Display System - Replacement (CCPDS-R)
83	Cheyenne Mountain Complex	Communications System Segment - Replacement (CSSR)
84	Cheyenne Mountain Complex	Granite Sentry
85	Cheyenne Mountain Complex	Space Defense Operations Center (SPADOC)
86	Cheyenne Mountain Complex	Survivable Communications Integration System (SCIS)
87	Combat Service Support Control System (CSSCS)	–
88	Communications Automations	VMACS (V5)

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
89	Communications Automations	VMACS II
90	Consolidated Automated Support System (CASS)	–
91	Countermeasures Decoy Dispensing System TACAIR EW	Fleet Airborne Electronic Warfare System
92	DMS	AUTODIN Switching Center (ASC)
93	DMS	Message Conversion System (MCS)
94	DMS	Proof of Concept Network
95	Dual Mode Seeker	–
96	E-2C (baseline) Group II	L-304 CP (OL-424/ASQ)
97	E-2C	Mission Computer Upgrade (MCU)
98	E-4B	Automated Data Processing (ADP) System
99	E-4B	Message Processing System
100	E-4B	Super High Frequency (SHF) System
101	EA-6B Prowler	–
102	ES-3A	–
103	Electro-Optical Targeting Sensors	Gunship Ballistic Winds Sensor
104	F-16	NMC Blocks 30 40 and 50
105	F-16	Non-NMC Blocks 30 40 and 50
106	F-22	Air Vehicle
107	FAAD C2 Engineering Development Program	–
108	FAAD Command & Control Engineering Development	–
109	FAAD Ground Based Sensor	MPQ64
110	FAAD Ground Based Sensor	Simulation Support
111	Fixed Distributed System (FDS)	Shore Signal & Information Processing Segment
112	Fleet Satellite Communications (FLTSATCOM), now UHF SATCOM Terminals	Common User Digital Information Exchange System
113	HARM	Command Launch Computer (CLC)
114	HARM	Missile Software
115	HARM	Simulation Software
116	HAVE P	Baseline
117	HAVE P	Mod for PEP
118	HAWK Air Defense System	HAWK IIIA
119	HAWK Air Defense System	HAWK IIIA Major Mod

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
120	HAWK Air Defense System	Phase III Hawk System
121	IONDS (Integrated Operational Nudets Detection System)	Integrated Correlation and Display System
122	IONDS (Integrated Operational Nudets Detection System)	Nudet Detection System (NDS)
123	IUSS	SOSUS
124	JAVELIN	–
125	Joint Direct Attack Munition	–
126	Joint Services Imagery Processing Systems (JSIPS)	–
127	Joint Services/Navy Standard Avionics Components & Subsystems	GPWS CAT I
128	Joint Services/Navy Standard Avionics Components & Subsystems	GPWS III HE/O
129	Joint Standoff Weapon (JSOW)	Baseline
130	Joint Surveillance Target Attack Radar System (Joint STARS)	–
131	Joint Tactical Information Distribution System (JTIDS)	–
132	LANTIRN	Navigation Pod
133	LANTIRN	Target Pod
134	Line-of-Sight Anti-Tank (LOSAT)	–
135	Link-16 Joint Tactical Information Distribution System (JTIDS)	–
136	Longbow Apache	–
137	M-1 Abrams Tank	–
138	M-31 FCT	SSST
139	MC-130H Combat Talon II	–
140	MCS V12 Prototype, Release 2	–
141	MH-53E	Mission Planning Station (MPS)
142	MH-53E	Navigation/Communication System (NCS)
143	MH-60G Helicopter	VSDS
144	MILSTAR Satellite Communications Systems	Mission Planning Element
145	MILSTAR Terminals	SCAMP (Single Channel Antijam Manportable Terminal)
146	MILSTAR Terminals	SMART-T (Raytheon)
147	MILSTAR Terminals	SMART-T (Rockwell)

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
148	MILSTAR	Defense Satellite Communication System (DSCS), Generic Telemetry Simulator (GTS)
149	MILSTAR	Defense Satellite Communication System (DSCS), Satellite Analyst Workstation (SAWS)
150	MILSTAR	Defense Satellite Communication System (DSCS), Telemetry Gathering and Archiving System (TGAS)
151	MILSTAR	MILSTAR Space Segment
152	MILSTAR	–
153	MIM-72G (Rosette Scan Seeker) Missile	Chaparral
154	MK-15 Close-in Weapons Systems (CIWS/ Phalanx)	PHALANX Block 0 & Block 1, Baselines 0,1, 2
155	MK-15 Close-in Weapons Systems (CIWS/ Phalanx)	PHALANX Block 1 Baseline 2 W/HOLC and beyond
156	MK-30 Target Development	MK 30 MOD2 ASW Training Target System
157	MK-30 Target Development	MK 30 MOD2 ASW Training Target System
158	MK-48 Advance Capability (ADCAP)	ADCAP Modifications (MO-OS)
159	MK-48 Advance Capability (ADCAP)	–
160	MLRS Launcher	Basic System
161	MLRS Launcher	Extended Range MLRS, IFCS
162	MLRS Product Improvement Program	Fire Direction Data Manager
163	MQM-8G (EER)	Vandal
164	MQM-8G (ER)	Vandal
165	Marine Corp Intelligence Analysis System	IAS
166	MILSTAR	–
167	Mine Hunter Costal (MHC)	–
168	Mine Hunting Sonar System	A/N 374-1
169	Mine Hunting Sonar System	AMNSYS
170	Mine Hunting Sonar System	AQS-20
171	Missile Simulation	–
172	Multi-Role Survivable Radar	–
173	Multifunctional Information Distribution System (MIDS)	–
174	Multiple Launch Rocket System (MLRS) Terminal Guidance Warhead (TGW)	Improved Fire Control System
175	Multiple Launch Rocket System (MLRS)	Extended Range MLRS, BGSR Launcher
176	NCCS Ashore	OSS

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
177	NCCS Ashore	TSC
178	NTDS Software Improvements/Advanced Combat Direction System (ACDS) Block I	–
179	Night Vision Combat Vehicles	Second Generation Tank Sight
180	Non-Cooperative Target Recognition Electronic Support Measures (NCTR-ESM)	AN/VSX-2
181	Noncooperative Identification Subsystems	Combat ID Program - Hughes Aircraft
182	Noncooperative Identification Subsystems	Combat ID Program - Inhouse
183	North Warning System	Unattended Radar
184	OH-58D KIOWA Warrior	Control/Display Subsystem Operational Flight Program
185	OH-58D KIOWA Warrior	Mast Mounted Sight
186	Ocean Surveillance Information System Baseline Upgrade (OSIS OBU)	–
187	P-3 Upgrade	AN/USQ-78
188	P-3 Upgrade	AN/USQ-78A
189	P-3 Upgrade	CP-2044 (System Test Program)
190	P-3 Upgrade	CP-2044 (Tactical Mission Software)
191	P-3 Upgrade	CP-901 (Operational Program)
192	P-3C Sensor Integration	Air Common Acoustic Processing (ACAP)
193	Patriot Air Defense Missile System	Patriot Advanced Capability - 3 (PAC-3)
194	Phoenix	AIM-54C Missile, Tactical Software
195	QF-4 Full Scale Aerial Target	Airborne System Test Set
196	QF-4 Full Scale Aerial Target	Automatic Flight Control Computer
197	QF-4 Full Scale Aerial Target	Ground Station Simulator
198	QF-4N	Fullscale Aerial Target (FSAT)
199	QF-4S	Fullscale Aerial Target (FSAT)
200	RAM	Block I (IRMU)
201	RAM	Guided MIssile Launching System, MK 144
202	Radar Upgrade	F/A 18 Radar Upgrade
203	S-3 Viking Modification	S-3 Co-Processor Memory Unit, AYK-23
204	S-3 Viking Modification	S-3 General Purpose Digital Computer AYK-10
205	SATCOM Ship Terminals, now EHF SATCOM Terminals	–
206	SATCOM Ship Terminals, now SHF SATCOM Terminals	–

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
207	SSN-21 Seawolf Program	Air Firing Valve Electronic System (AFVE)
208	SSN-21 Seawolf Program	AN/WLQ-4(V)1
209	SSN-21 Seawolf Program	BSY-2 Combat System
210	SSN-21 Seawolf Program	Circuit-D
211	SSN-21 Seawolf Program	Data Distribution System
212	SSN-21 Seawolf Program	Monitoring System
213	SSN-21 Seawolf Program	Periscope System
214	SSN-21 Seawolf Program	Ship Control System
215	SSN-21 Seawolf Program	Weapons Storage and Handling
216	SOF Aircrew Training System (ATS)	–
217	SOF Airdrop Advanced Development	ATD for AALC, (GPADS) Guided Parafoil Aerial Delivery System
218	SOF Airdrop Advanced Development	Draper Labs ACT II BAA, Parafoil GN&C
219	SSN-688 Los Angeles	AN/BQQ-SE
220	SSN-688 Los Angeles	AN/BSY-1, ECI-010 Baseline
221	SSN-688 Los Angeles	CCS MK1, Program C4.2V1
222	SSN-688 Los Angeles	CCS MK2, Program D0
223	SSSEP	Advanced Submarine Tactical ESM Combat System
224	SSSEP	Photonics Mast
225	SURTASS (Surveillance Towed Array Sensor System)	SURTASS Production
226	SURTASS	Advanced Deployable System
227	SURTASS	SURTASS LFA (FSED)
228	Seeker Advanced Development Program	Small Diameter Imaging System
229	Sensor Fuzed Weapon (SFW)	–
230	Sidewinder	AIM-9X
231	Signal Processor Vehicle Interface	Airborne System Test Set
232	Simulator for Electronic Combat Training (SECT)	AN/FSQ-T25 Electronic Combat Trainer
233	Space Boosters Rocket Systems	Delta Redundant Measurement Systems
234	Space Boosters Rocket Systems	Inertial Upper Stages
235	Space Boosters Rocket Systems	Medium Launch Vehicle (MLV-II), Atlas Launch Vehicle
236	Space Boosters Rocket Systems	Redundant Inertial Flight Control Assembly
237	Space Experiments for Phenomenology and Technology Demonstrations	–

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
238	Sparrow AIM/RIM-7R Weapon System	–
239	Special Operations Aircraft	Integrated Avionics Subsystem
240	Standard Missile 2 - Block IV	AEGIS ER
241	Standard Missile Improvements	MHIP-SM-2 BLK IIIB Infrared Seeker Computer
242	Standard Missile Improvements	MHIP-SM-2 BLK IIIB Missile Control Computer
243	Standard Theatre Army Command and Control System	STACCS
244	Standoff Land Attack Missile (SLAM)	Baseline
245	Standoff Land Attack Missile (SLAM)	Upgrade
246	Stinger RPM Block 1	–
247	Stinger RPM	–
248	Submarine Support Equipment Program (SSEP)	–
249	Submarine Tactical Communication System	Submarine Message Buffer
250	Surface Ship Torpedo Defense (SSTD)	AN/SLR-24 Detection and Launched Countermeasures Subsystems
251	System Simulator/Simulations	Target Oriented Tracking System
252	T-45TS Goshawk Trainer	Operational Flight Trainer (OFT)
253	T-45TS Goshawk Trainer	T-45A Aircraft
254	TACAIR EW	AAR-47 Missile Warning Set
255	TACAIR EW	AAR-47 Missile Warning Set (Upgrade)
256	TACAIR EW	ALE-47 Countermeasures Dispenser
257	TACAIR EW	ALQ-126B RCVR/Jammer
258	TACAIR EW	ALQ-157 IR Jammer
259	TACAIR EW	ALQ-162 Tactical Simulation POD
260	TACAIR EW	ALQ-167/AST-6 Tactical Simulation POD
261	TACAIR EW	ALR-67 (v) 3 & 4 Radar Warning RCVR
262	TACAIR EW	AN/ALE-50
263	TACAIR EW	AN/ALQ-170 (V) Tactical Simulation POD
264	TACAIR EW	AN/ALR-67(v)2 ECP51D Countermeasures Receiving Set
265	TACAIR EW	AVR-2 Laser Detecting Set
266	TALD and ITALD	–
267	TARTAR Support Equipment	Communications Tracking Set AN/SYR-1 EHESPA
268	TARTAR Support Equipment	Missile Fire Control System MK 74

Table B-1. Weapon Program/System Names (Continued)

No.	Program Name	System Name
269	TARTAR Support Equipment	TARTAR Common (was MK 14)
270	TERPES	TERPES Upgrade
271	TRI-TAC	System Planning System Control
272	Tactical Electronic Reconnaissance Processing & Evaluation System (TERPES)	TERPES Phase II
273	Tactical Electronic Surveillance Systems - AD	Concurrent Systems Baseline, Enhanced Tactical Users Terminal
274	Tactical Electronic Surveillance Systems - AD	SUCCESS UHF Radio
275	Tactical Electronic Surveillance Systems - AD	Unix Systems Baseline, Mobile tactical Terminal
276	Tactical Electronic Surveillance Systems - AD	Communications System Processor
277	Tactical Environmental Support Systems Engineering	Tactical Environmental Support System (TESS (3))
278	Tactical Satellite Communications (TACSATCOM)	AN/PSC-5 Enhanced Manpack UHF Terminal (EMUT)
279	Tanker Transport Trainer System	T-1A SIM
280	Tanker Transport Trainer System	T-1A TMS
281	Tomahawk Modifications	Advanced Tomahawk Weapon Control System (ATWCS)
282	Tomahawk Modifications	Baseline Improvement Program (Block IV Operational Embedded Software only)
283	Tomahawk Modifications	Theater Mission Planning Center/Afloat Planning
284	Tomahawk Modifications	Enhancement to Support TBIP
285	Tomahawk	Baseline Weapon Control System
286	Tomahawk	TLAM-Conventional (R/UGM-109C/D)
287	Tomahawk	TLAM-Nuclear (R/UGM-109A)
288	Training Devices/Simulators	Marine Air Ground Task Force (MAGTF) Tactical Warfare Simulation (MTWS)
289	UHF SATCOM Terminals	Demand Assigned Multiple Access
290	UHF SATCOM Terminals	SATCOM Signal Analyzer
291	UHF SATCOM Terminals	Submarine Satellite Information Exchange System
292	UHF SATCOM Terminals	Tactical Data Information Exchange System
293	UHF SATCOM Terminals	Tactical Intelligence
294	USQ-74	Link-11
295	V-22 Osprey	–
296	Wide Area Mine	–

B.1.2 List of AIS Program/System Names

Table B-2. AIS Program/System Names

No.	Program Name	System Name
297	AFMIS	–
298	CAS	Combat Ammunition System - Deployable (CAS-D)
299	CAS	Combat Ammunition System - Command (CASE)
300	CAS	Combat Ammunition System - Ammunition Control Point (CAS-A)
301	CAS	Combat Ammunition System - Base (CAS-B)
302	DARP	–
303	Defense Civilian Personnel Data System (DCPDS)	–
304	Department of Army Movements Management System - Redesign (DAMMS-R)	Block I
305	Department of Army Movements Management System - Redesign (DAMMS-R)	Block II
306	Department of Army Movements Management System - Redesign (DAMMS-R)	Block III
307	Depot Maintenance Standard System (DMSS)	DM-HMMS
308	Depot Maintenance Standard System (DMSS)	DMMIS
309	Depot Maintenance Standard System (DMSS)	PDMSS
310	Depot Maintenance Standard System (DMSS)	TIMA - ATICTS
311	Distribution Standard System (DSS)	–
312	Electronic Military Personnel Records System (EMPRS)	Defense Personnel Records Imaging System (DPRIS)
313	Fuels Automated Management System (FAMS)	–
314	GCCS	Force Augmentation Planning and Execution System (FAPES)
315	GCCS	JOPES Version 3.3.3
316	GCCS	LOGSAFE 283V
317	GCCS	Scheduling and Movement
318	ISM	–
319	Joint Computer-Aided Acquisition and Logistic Support (JCALS)	–
320	NALCOMIS IMA	–
321	NALCOMIS OMA	–
322	Primary Oceanographic Prediction System	–
323	Requirements Data Bank (RDB)	–

Table B-2. AIS Program/System Names (Continued)

No.	Program Name	System Name
324	Reserve Component Automation System (RCAS)	–
325	SARSS	SARSS-2AC/B
326	SARSS	SARSS-2AD and SARSS-1
327	SBIS	–
328	Source Data Systems	–
329	Standard Installation/Division Personnel System (SIDPERS)	SIDPERS-3
330	Stock Point ADP Program (SPAR)	UADPS-SP
331	TAMMIS	–
332	Transportation Operational Personal Property Standard System (TOPS)	–
333	Unit Level Logistics System (ULLS)	ULLS - A
334	Unit Level Logistics System (ULLS)	ULLS - G
335	Unit Level Logistics System (ULLS)	ULLS - S4

B.2 Remaining Survey Data

This section of the appendix provides a list of all survey responses excluding "Program Name" and "System Name" (which are found in Section B.1). The rows have been arbitrarily mixed to prevent association of survey response and program/system name. A number of abbreviations or codes are used in this section of the appendix:

a. For the Service associated with the Program Name: Air Force (F), Army (A), Navy (N), DISA (D), Marine Corps (M). Agencies and other organizations are denoted by (O).

b. For Acquisition Category: I (A), II (B), III (C), and IV (D).

c. For SLOC (in thousands), 1-100 (A), 100-500 (B), 500-1,000 (C), 1,000-5,000 (D), and 5,000+ (E).

d. For Acquisition Phase: Concept Exploration (A), Demonstration/Validation (B), Engineering and Manufacturing Development (C), Production and Deployment (D), and Major Modification (E).

e. For Percent of Language Use: less than 5% (A), 5-25% (B), 25-50% (C), 50-75% (D), and greater than 75% (E). Note that if the survey response provided exact percentages, they are included in parenthesis.

For example, the first row in Table B-3 reflects a response by an Air Force program/ system, acquisition category I, in the Production and Deployment acquisition phase, having 100-500K of SLOC, with five programming languages (Assembly - <5%, Fortran pre-91/ 92 - <5%, Jovial J73 - 5-25%, PL/I 76/87/93 - 50-75%, and ATLAS - <5%).

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
336	F	A	D	B	Assembly - A Fortran pre-91/92 - A Jovial J73 - B f PL/I 76/87/93 - D ATLAS - A

B.2.1 Weapon System Survey Data

Table B-3. Weapon System Survey Data

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
336	F	A	D	B	Assembly - A Fortran pre-91/92 - A Jovial J73 - B f PL/I 76/87/93 - D ATLAS - A
337	F	C	D	A	Assembly - C (30%) Ada 83 - D (60%) 4GL - B (10%)
338	N	A	D	A	C89 - E (100%)
339	N	C	D	D	C89 - A (1%) CMS-21 - E (98%) Others - A (1%)
340	N	A	D	D	Ada - E (100%)
341	N	A	D	A	Ada - E (100%)
342	N	A	D	A	Assembly - B (10%) C89 - E (90%)
343	N	A	D	A	Assembly - A (2%) C89 - E (98%)
344	N	C	D	A	C89 - A (3%) CMS-2M - E (92%) Others - A (5%)
345	N	A	D	A	Assembly - A(4%) Ada - D (56%) C89 - C (40%)
346	N	A	D	A	Ada - E (100%)
347	A	A	E	B	Assembly - B Ada - E C89 - E ATLAS - E
348	A	C	B	A	Assembly - A Ada - E C89 - B
349	A	B	C	A	Machine - A Ada - E
350	A	C	B	B	Assembly - A Ada - E C89 - A
351	N	D	E	A	Assembly - E C++ - B Others - B
352	F	D	D	B	Fortran pre-91/92 - E
353	F	A	D	B	Ada 83 - E (100%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
354	F	D	D	D	C89 - B Fortran pre-91/92 - D
355	F	–	D	A	Assembly - E ATLAS - E
356	F	–	D	A	Assembly - B Jovial pre-J73 - E
357	F	–	C	A	Assembly - B Ada 83 - E
358	F	–	C	A	Assembly - E
359	F	–	D	–	–
360	F	–	C	A	Assembly - B Jovial pre-J73 - E
361	F	–	D	A	Assembly - E
362	F	A	C	B	Ada 83 - E
363	F	A	D	B	C89 - B Fortran pre-91/92 - E
364	F	A	C	D	Ada 83 - E
365	F	A	D	C	Assembly - B C89 - A Fortran pre-91/92 - E
366	F	A	C	B	Ada 83 - E
367	A	A	C	–	Assembly Ada 83 C++ Fortran 91/92,3 Jovial pre-J73 Pascal pre-90 Prolog 4GL DTC
368	O	–	D	C	Assembly - E (89%) Fortran pre-91/92 - A (6%) C++ - A (5%)
369	O	–	D	B	Ada 83 - B (25%) C89 - D (75%)
370	O	–	B	E	C89 - E (100%)
371	F	D	D	B	Machine - A Jovial J73 - E
372	F	D	D	B	Machine - A Ada 83 - E
373	F	D	D	A	Machine - B Fortran pre-91/92 - E

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
374	N	D	D	C	Assembly - C (29%) Ada 83 - B (8%) C89 - C (29%) C++ - A (3%) CMS-2M - B (12%) Pascal pre-90 - C (19%)
375	N	D	D	A	Assembly - E
376	N	B	C	B	Ada 83 - E
377	F	–	E	A	Assembly - D C++ - B
378	F	–	D	A	Assembly - E
379	N	D	C	–	C89 - E
380	N	D	C	B	Assembly - B Ada 83 - D Pascal pre-90 - B Others - B (Screen Descriptor Language)
381	N	D	C	–	Assembly - E
382	N	D	B	–	Assembly Fortran pre-91/92
383	N	D	D	–	Assembly - E
384	N	C	D	–	PL/M (Intel) - E
385	N	D	C	–	Assembly - E
386	N	D	D	–	Assembly C++ Fortran
387	N	D	C	–	Assembly C++ Fortran
388	N	D	D	–	Assembly - E
389	N	D	C	–	Assembly - E
390	F	A	D	E	Assembly - B (15%) Jovial J73 - E (85%)
391	F	A	C	E	Assembly - A Ada 83 - C Jovial J73 - D ATLAS - A
392	A	D	D	A	Assembly - E

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
393	N	A	C	D	Ada 83 - D Fortran pre-91/92 - B Assembly - B C89 - B Jovial - A Pascal - A PL/M - A
394	N	B	C	C	Assembly - B (10%) Ada 83 - A (3%) Basic 87/93 - B (8%) C89 - B (8%) Fortran 91/92 - A (3%) Jovial J73 - D (68%)
395	N	B	C	C	Assembly - A (8%) Ada 83 - B (14%) Basic 87/93 - B (8%) C89 - B (8%) Fortran pre-91/92 - B (3%) Jovial J73 - D (66%)
396	N	–	D	A	Assembly - E (100%)
397	A	–	D	B	C89 - E
398	A	–	D	D	Assembly - E
399	A	–	E	B	Ada 83 - E
400	A	A	C	C	Assembly - B (24%) C89 - B (18%) Others - (13%) 4GL - A (3%) GPSS - A (1%)
401	N	A	D	B	Ada 83 - B (6%) Basic 87/93 - A (1%) Fortran pre-91/92 - B (15%) Pascal pre-90 - B (6%) PIL -C (25%) VAX Macro - B (8%) VTL - C (39%)
402	N	A	D	A	Assembly - D (51%) Fortran pre-91/92 - B (21%) PIL - C (25%) Vax Macro - A (3%)
403	N	A	D	C	Assembly - C (35%) C89 - A (4%) Fortran pre-91/92 - D (58%) 4GL - A (3%)
404	F	–	D	B	Assembly - A (3%) Basic 87/93 - B (25%) Fortran pre-91/92 - C (49%) Jovial J73 - C (33%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
405	F	D	E	A	Jovial J73 - E (100%)
406	F	C	C	A	Ada 83 - E (100%)
407	F	–	C	A	Ada 83 - E (100%)
408	F	D	–	A	C++ - E (100%)
409	F	B	D	C	Assembly - B Ada 83 - B C89 - A Fortran pre-91/92 - B Jovial J73 - C Pascal pre-90 - A PLM - B
410	N	C	D	A	Ada 83 - E (100%)
411	A	A	D	B	Assembly - B (22%) Ada 83 - D (67%) C89 - A (3%) Fortran pre-91/92 - B (7%) Pascal 90 - A (<1%)
412	M	A	A	B	Ada 83 - E (100%)
413	N	B	A	B	Ada 83 - D (53.4%) C89 - B (7.4%) C++ - C (39.2%) Fortran pre-91/92 - A 4GL - A
414	A	–	B	B	Ada 83 - E VHDL - D
415	A	A	C	C	Ada 83 - E C89 - A
416	N	A	C	B	Assembly - C Ada 83 - C C89 - A C++ - A ATLAS - C
417	N	A	B	A	Ada 83 - C C89 - E
418	F	–	–	A	C89 - E
419	F	D	B	A	Assembly - A (4%) C89 - E (96%)
420	F	–	B	A	Assembly - A Ada 83 - E
421	M	C	D	B	Ada 83 - C C89 - B Fortran pre-91/92 - B Pascal pre-90 - A 4GL - B

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
422	F	A	C	D	Assembly - B (10.3%) Ada 83 - E (89.54%) C89 - A (0.2%)
423	A	C	B	A	Assembly - A Ada 83 - E C89 - B
424	F	C	C	B	Ada 83 - E C89 - A
425	N	A	D	B	Assembly - C Others - C
426	F	–	D	A	Ada 83 - E (100%)
427	F	–	D	A	Ada 83 - E (100%)
428	F	–	D	A	Ada 83 - E (100%)
429	F	–	D	A	C89 - D (75%) Fortran - B (25%)
430	F	–	E	A	Jovial J73 - E (100%)
431	F	–	E	A	Jovial J73 - E (100%)
432	N	C	D	B	Assembly - C Ada 83 - B C89 - B Pascal pre-90 - B PLM-86 - C
433	N	D	D	B	Assembly - E (100%)
434	N	C	C	B	Ada 83 - E (100%)
435	M	D	A	B	C++ - E (100%)
436	M	B	D	D	Assembly - C (40%) C89 - B (6%) CMS-2M - C (50%) Fortran pre-91/92 - A (0.4%) Pascal pre-90 - A (4%)
437	N	D	B	A	Assembly - E C89 - B
438	N	B	C	B	Assembly - D (51%) Ada 83 - C (44%) C89 - C (5%)
439	N	C	C	A	Ada 83 - E C89 - B
440	N	C	C	A	Ada 83 - E (100%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
441	O	–	–	C	Assembly - B (9%) Ada 83 - A (3%) C89 - B (12%) Fortran pre-91/92 - D (58%) Pascal pre-90 - B (9%) Pascal 90 - B (9%) Others - A (0.5%)
442	A	A	D	D	Ada 83 - B (10.6%) C89 - C (38.8%) Fortran pre-91/92 - C (44.8%) Pascal pre-90 - A (4.7%) Others - A (1.1%)
443	N	A	C	D	Assembly - C (30%) Ada 83 - D (65%) CMS-2M - B (5%)
444	N	C	D	B	Assembly - D Fortran pre-91/92 - B
445	N	A	D	B	CMS-2M - E PL/I 76/87/93 - B
446	N	A	C	B	Ada 83 - D C++ - C
447	A	–	D	B	Assembly - E (100%)
448	A	–	D	A	Pascal pre-90 - E (100%)
449	A	B	C	A	Assembly - B (10%) Ada 83 - E (90%) ATLAS - E
450	A	A	C	B	Ada 83 - C C89 - C 4GL - A
451	A	A	D	C	Assembly - B (8.1%) Ada 83 - A (2.4%) Fortran pre-91/92 - B (19.1%) Jovial J73 - B (6.5%) Pascal pre-90 - D (63.2%)
452	A	A	E	B	Ada 83 - C (39%) Fortran pre-91/92 - C (26%) Jovial J73 - C (28%) Pascal pre-90 - B (8%)
453	A	A	E	A	Ada 83 - D (66%) Fortran pre-91/92 - B (22.6%) Jovial J73 - A (3.1%) Pascal pre-90 - B (8.3%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
454	A	A	C	B	Assembly - B (9.5%) Ada 83 - B (9%) C++ - C (29.8%) Fortran pre-91/92 - C (44%) Others - C (7.7%)
455	A	–	–	D	Ada 83 - C C89 - D GPSS - A
456	A	B	D	A	Assembly - E (100%)
457	M	D	C	B	Ada 83 - C (50%) C89 - C (50%)
458	F	A	E	C	Assembly - B (21.4%) Ada 83 - B (10%) Jovial pre-J73 - D (53.6%) Jovial J73 - B (15%)
459	F	C	D	D	Fortran pre-91/92 - E Jovial J73 - A
460	F	D	D	A	Jovial pre-J73 - C Jovial J73 - C
461	F	D	D	A	Jovial pre-J73 - B Jovial J73 - E
462	O	A	B	B	Ada 83 - E (100%)
463	N	C	D	A	Assembly - A CMS-2 M - E
464	N	–	D	A	Assembly - E (100%)
465	N	D	D	B	Machine - E (100%)
466	N	D	E	C	C89 - E (100%)
467	N	B	D	D	Assembly - B Fortran pre-91/92 - D Pascal pre-90 - B ATLAS - C
468	N	B	D	B	Assembly - E (100%)
469	A	–	A	–	C89 - E (90%) Fortran 91/92 - B (10%)
470	N	C	D	C	Assembly - A Ada 83 - C C89 - B CMS-2 M - C Pascal pre-90 - A 4GL - A
471	F	D	B	A	Assembly - B (15%) C89 - D (67%) Jovial J73 - B (8%) Pascal pre-90 - (10%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
472	F	A	B	B	Assembly - B (9%) C89 - C (37%) Fortran pre-91/92 - C (46%) Jovial J73 - B (7%) VHDL - A (1%)
473	F	A	B	B	C89 - D (70%) C++ - B (10%) Fortran 91/92 - B (20%)
474	N	B	C	A	Ada 83 - E (100%)
475	N	B	C	A	Assembly - E (100%)
476	N	C	C	A	Assembly - C (29%) C++ - D (71%)
477	N	D	D	B	Assembly - B (16%) Pascal pre-90 - E (84%)
478	N	C	D	A	Machine - A Assembly - B Others - E (80%)
479	N	C	D	A	Assembly - E (100%)
480	N	C	D	B	Assembly - B (6%) Others - E (94%)
481	N	–	CD	B	Assembly - B C89 - C C++ - B CDL - E
482	N	C	D	A	Assembly - E (100%)
483	N	B	DE	A	Machine - A Assembly - B C89 - E
484	N	C	C	B	Assembly - B Ada 83 - E
485	N	C	C	A	Assembly - D Ada 83 - D
486	N	C	D	A	Assembly - E (100%)
487	N	C	D	A	Assembly - B Fortran pre-91/92 - E
488	N	C	E	A	Ada 83 - E (100%)
489	A	C	D	A	Assembly - C (29.4%) Ada 83 - C (36%) C89 - C (35.6%)
490	F	A	D	D	Ada 83 - E (98%) C89 - A (2%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
491	F	A	D	D	Assembly - A (3%) Ada 83 - D (67%) 4GL - C (30%)
492	N	B	D	C	Assembly - D (55%) Ada 83 - C (45%)
493	N	B	D	B	Assembly - D (58.4%) CMS-2M - C (41.6%)
494	N	B	D	A	Assembly - C (30%) CMS-2M - D (70%)
495	N	A	D	A	Assembly - E (100%)
496	N	A	D	A	Assembly - D Ada 83 - B Jovial J73 - C
497	N	B	D	C	Assembly - C C89 - A Fortran pre-91/92 - C
498	N	C	C	D	Ada 83 - D C89 - C C++ - B Others - A 4GL - B
499	N	A	C	C	Ada 83 - D C89 - A C++ - A Fortran 91/92 - C
500	N	A	C	B	Assembly - B Ada 83 - C C89 - B Fortran 91/92 - B Jovial J73 - B
501	N	A	C	D	Ada 83 - E C89 - A 4GL - A
502	M	D	–	B	Ada 83 - E C89 - B
503	A	A	C	C	Assembly - A Ada 83 - E C89 - A Fortran pre-91/92 - E
504	A	A	D	D	Machine - E C++ - B (14%)
505	A	A	D	A	Fortran - C C89 - C

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
506	N	A	C	B	Ada 83 - D (53%) C89 - B (7%) C++ - C (39%) 4GL - B (5%)
507	N	C	D	B	Assembly - D C89 - C
508	N	B	D	B	Assembly - A Ada 83 - E C89 - A
509	N	D	D	A	Machine - A Assembly - A C89 - E
510	N	C	D	B	Assembly - E C89 - E
511	N	C	C	B	Assembly - D Ada 83 - D C89 - D Basic 78 - A C++ - C Fortran pre-91/92 - A Fortran 91/92 - A
512	N	C	D	A	Assembly - E
513	M	D	D	B	C89 - E 4GL - B
514	F	C	D	A	Assembly - B Ada 83 - B C89 - E
515	F	C	D	C	Ada 83 - D (60%) C89 - C (40%)
516	F	–	C	B	Assembly - A Ada 83 - C C89 - B Fortran pre-91/92 - A Jovial J73 - C ATLAS - A
517	N	A	E	B	Assembly - B Ada 83 - E Pascal pre-90 - B
518	N	A	E	A	Fortran pre-91/92 - E Others - B
519	F	A	D	C	Machine - A Ada 83 - C C89 - C Fortran pre-91/92 - B

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
520	F	B	C	D	Machine - A Assembly - B Ada 83 - A Fortran pre-91/92 - E
521	F	D	D	B	Assembly - B (25%) Jovial pre-J73 - E (75%)
522	F	D	D	C	Assembly - B Jovial J73 - E
523	–	–	–	–	Assembly - C Ada 83 - C C89 - B Pascal pre-90 - B
524	A	A	D	B	Assembly - A Ada 83 - E C89 - A
525	–	–	D	B	Assembly - C (40%) Jovial J73 - D (60%)
526	–	–	D	B	C89 - C Pascal pre-90 - C
527	A	A	C	B	Assembly - A Ada 83 - E 4GL - B
528	A	A	C	B	Assembly - A Ada 83 - D C++ - B
529	A	A	C	B	Assembly - B Ada 83 - E
530	N	A	D	–	Assembly - A (2.71%) C89 - A (4.58%) CMS-2 M - A (2.43%) Fortran pre-91/92 - B (8.21%) Others - E (82.1%)
531	N	A	D	B	Assembly - D Ada 83 - B CMS-2 M - B
532	N	B	E	B	Assembly - E Ada 83 - B
533	A	–	–	B	C++ - A Fortran pre-91/92 - D Fortran 91/92 - C 4GL - A
534	N	B	D	B	Assembly - C C89 - C 5GL - C

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
535	N	B	C	C	Ada 83 - D C++ - C 5GL - C
536	N	D	B	A	Ada 83 - E C89 - A
537	A	A	D	C	Assembly - B Fortran pre-91/92 - B Jovial J73 - B Pascal pre-90 - B 4GL - A Special purpose - B
538	A	C	C	A	Ada 83 - E Fortran pre-91/92 - A
539	A	–	D	B	Ada 83 - E
540	A	C	C	A	Assembly - C Fortran pre-91/92 - C Jovial J73 - D
541	N	–	C	C	Machine - A Assembly - B Ada 83 - B Basic - B C89 - B Fortran pre-91/92 - B Fortran 91/92 - B Special purpose - B
542	A	A	B	B	Assembly - A C89 - E
543	A	C	C	C	Ada 83 - E C89 - B Fortran pre-91/92 - A 4GL - A Special purpose - B
544	A	C	C	A	Assembly - E (90%) C89 - B (10%)
545	N	C	D	C	Assembly - B C89 - B Fortran pre-91/92 - B Pascal pre-90 - D
546	N	A	D	C	Assembly - B PL/I 87/93 subset - E
547	N	–	D	–	Assembly Jovial J73
548	A	B	C	B	Assembly - D Ada 83 - C

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
549	A	B	C	A	Assembly - D Ada 83 - A
550	–	B	C	A	Assembly - A (5%) Ada 83 (80%) Other - B (15%)
551	–	B	D	B	Assembly - E (100%)
552	–	D	C	C	Ada 83 - E
553	–	D	E	C	CMS-2 Y - E
554	N	C	D	B	Machine - C Assembly - C C89 - B Fortran pre-91/92 - A
555	N	A	D	B	Assembly - B Fortran pre-91/92 - D
556	F	A	D	A	Assembly - E
557	F	C	C	B	Ada 83 - E
558	–	–	D	B	Assembly - B (22%) Ada 83 - B (7%) Jovial J73 - D (71%)
559	F	B	D	B	Assembly - B (5%) Ada 83 - D (60%) Jovial J73 - C (35%)
560	F	B	E	C	Assembly - A (1%) Ada 83 - A (2%) C89 - E (90%) Basic89 - A (3%)
561	F	B	D	B	Assembly - D (57%) Basic89 - B (7%) C89 - C (36%)
562	F	–	–	D	Machine - A (0.1%) Assembly - A (3.9%) Fortran pre-91/92 - D (64.3%) C89 - A (0.7%) Jovial J73 - A (4.9%) Ada 83 - A (4.9%) Others - C
563	N	B	C	A	Machine - D Ada 83 - A
564	N	A	D	A	Assembly - E
565	N	A	C	A	Assembly - E
566	N	–	–	–	Assembly - B (5%) Ada 83 - E (90%) Others - B (5%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
567	N	C	A	B	Ada 83 - D (75%) Others - C (25%)
568	N	C	A	B	Assembly - C (40%) Ada 83 - D (60%)
569	N	D	D	A	Ada 83 - E
570	N	C	D	C	CMS-2 M - E Special purpose - B
571	N	B	B	B	Ada 83 - D (53.4%) C89 - B (7.4%) C++ - C (39.2%) Fortran pre-91/92 - A 4GL - A
572	N	C	E	C	Assembly - A C89 - E CMS-2 M - A 4GL - A
573	O	–	A	B	Assembly - A C89 - E
574	M	D	D	D	Ada 83 - A C89 - E C++ - B
575	M	D	B	D	C89 - E C++ - B
576	A	–	D	B	Assembly - A C89 - A Other - E
577	A	–	D	B	Assembly - A Fortran pre-91/92 - E
578	A	–	D	B	C89 - A C++ - D Fortran pre-91/92 - A 4GL - C
579	A	–	D	A	Assembly - A Other - E
580	N	D	D	D	Assembly - A C89 - D C++ - B Fortran pre-91/92 - B Lisp - A 4GL - A
581	F	A	C	C	Assembly - A Ada 83 - E C89 - A Fortran pre-91/92 - E

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
582	N	–	E	D	Ada 83 - B (20.48%) Basic 87/93 - B (10.46) C89 - B (8.23%) C++ - C (39.25%) CMS-2 M - B (6.7%) Fortran 91/92 - B (9.69%) Assembly - A (4.29%) 4GL - A (0.91%)
583	N	A	D	A	Fortran pre-91/92 - D
584	N	C	B	–	C++ - D
585	A	C	C	B	C++ - E Others - A
586	N	A	D	B	Assembly - B Ada 83 - A C++ - A Fortran pre-91/92 - E
587	F	A	C	C	Assembly - B (23%) C89 - A C++ - A Fortran pre-91/92 - B Jovial J73 - B Others - B (25%)
588	F	A	C	D	Assembly - A Ada 83 - E Fortran pre-91/92 - A Jovial pre-J73 - B Jovial J73 - B
589	F	B	D	A	Ada 83 - C (25%) C89 - D (75%)
590	F	B	D	A	C89 - B (5%) Fortran pre-91/92 - E (95%)
591	F	B	E	B	Assembly - B (15%) Fortran pre-91/92 - E (85%)
592	F	A	C	B	Ada 83 - E
593	N	D	B	A	Ada 83 - E C89 - A
594	A	–	B	A	Assembly - C Ada 83 - B C++ - B Others - C
595	N	B	C	C	Machine - C C++ - A CMS-2 Y - D CMS-2 M - A

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
596	N	C	D	C	Assembly - A (6%) Ada 83 - E (85%) C89 - B (9%)
597	N	C	D	B	Ada 83 - E
598	N	C	D	C	Assembly - A (15%) CMS-2 M - E (85%)
599	N	C	D	D	Assembly - E C89 - A
600	N	C	E	B	Assembly - C Ada 83 - D C89 - A 4GL - A
601	N	–	D	D	Assembly - C (43%) C89 - B (18%) C++ - A (0.23%) Others - B (10%) SPL/1 - C (29%)
602	A	–	A	A	Ada 83 - D C89 - C CSSL - A
603	N	D	C	E	Machine - A (1.71%) Assembly - C (29.26%) C89 - A (4.8%) CMS-2 M - C (31.34%) Pascal pre-90 - B (14.04%) PL/I 76/87/93 - A (2.06%) Others - B (12.45%) SPL/1 - A (3.29%)
604	N	C	C	D	Assembly - C (48.6%) CMS-2 M - A (4.4%) Others - B (16.7%) SPL/1 - C (30.3%)
605	N	D	D	D	Assembly - D CMS-2 Y - B CMS-2 M - B
606	N	B	C	D	Assembly - B Ada 83 - C C89 - B CMS-2 Y - C CMS-2 M - B
607	N	B	C	B	Assembly - B (9.09%) Ada 83 - C (42.17%) C++ - B (21.26%) Fortran 91/92 - C (27.48%)
608	A	B	C	A	Assembly - A (4%) Ada 83 - D (96%)

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
609	A	D	A	B	Assembly - C Fortran 91/92 - B Others - B
610	A	D	–	A	C89 - E
611	F	C	C	A	Assembly - B Ada 83 - E
612	F	C	C	A	Ada 83 - E
613	F	C	C	A	Fortran pre-91/92 - E
614	F	C	C	A	Ada 83 - E
615	N	–	C	A	Machine - A Assembly - B Basic 78 - A C89 - A Fortran pre-91/92 - D 4GL - B
616	F	–	A	A	Assembly - A Basic 78 - A C++ - A Fortran pre-91/92 - A Pascal pre-90 - A 4GL - A
617	F	C	C	A	Assembly - B Pascal pre-90 - D ATLAS - E
618	F	–	C	D	Assembly - A Ada 83 - E C89 - B Jovial J73 - A
619	A	A	C	B	Ada 83 - B C89 - C 4GL - C
620	A	C	C	D	Ada 83 - B (9%) C89 - D (67%) LISP - A (1%) 4GL - B (23%)
621	A	–	C	D	Ada 83 - C (40%) C89 - A (3%) Cobol pre-85 - A (3%) Others - A (2%) 4GL - D (52%)
622	N	A	D	B	Fortran pre-91/92 - D Pascal 90 - B C89 - B

Table B-3. Weapon System Survey Data (Continued)

No.	Service	ACAT	Phase	SLOC	Languages - % of Use
623	N	A	D	B	Fortran pre-91/92 - D Pascal 90 - B C89 - B
624	N	A	D	B	Fortran pre-91/92 - D Pascal 90 - B C89 - B
625	N	A	D	C	C89 - E C++ - B 4GL - B
626	N	–	C	C	CMS-2 Y - C (30%) Fortran pre-91/92 - B (10%) Pascal pre-90 - D (60%)
627	N	–	C	E	Assembly - A (1%) Ada 83 - A (1%) C89 - A (1%) CMS-2 Y - E (95%) Fortran 91/92 - A (1%) Pascal 90 - A (1%)
628	N	–	D	C	Assembly - A CMS-2 Y - E
629	N	C	E	D	Ada 83 - B C89 - D Others - B 4GL - B
630	N	C	E	B	Ada 83 - B (13%) C89 - C (47%) 4GL - C (40%)

B.2.2 AIS Survey Data

Table B-4. AIS Survey Data

No.	Serv	ACAT	Phase	SLOC	Languages - Percent of Use
631	F	B	D	D	Fortran 91/92 - A Cobol pre-85 - E 4GL - B
632	F	–	D	C	4GL - E
633	F	–	E	B	4GL - E
634	A	C	D	C	C89 - E (82.76%) 4GL - B (17.24%)
635	F	–	D	A	C89 - A 4GL - E
636	N	B	C	B	C89 - B 4GL - E
637	A	C	D	D	Ada 83 - A (2%) C++ - B (20%) Cobol 85 - E (78%)
638	A	C	D	D	Ada 83 - A (10%) C++ - B (20%) 4GL - E (70%)
639	F	C	C	B	Ada 83 - D Cobol pre-85 - B 4GL - B
640	A	B	C	C	Ada 83 - E Cobol 85 - B 4GL - A
641	F	B	E	A	Ada - E 4GL - B
642	F	B	D,E	B	Ada - E 4GL - B
643	A	–	C,D,E	C	4GL - E
644	O	A	C	D	Ada 83 - E 4GL - A
645	A	D	C, D	C	Ada 83 - E 4GL - B
646	F	B	D	D	Machine - B (10%) Cobol pre-85 - C (40%) Cobol 85 - B (49%) Fortran pre-91/92 - A (1%)
647	A	B	E	C	C89 - B (12.5) C++ - A (1%) 4GL - E (86.5%)

Table B-4. AIS Survey Data (Continued)

No.	Serv	ACAT	Phase	SLOC	Languages - Percent of Use
648	O	–	D	B	Ada 83 - E (81%) C89 - B (8%) Cobol - B (7%) Assembly - A (4%)
649	O	–	D	B	Ada 83 - B (11%) C89 - B (6%) 4GL - E (83%)
650	O	–	D	–	Ada 83 - E (90%) C89 - B (7%) Cobol - A (3%)
651	O	–	D	D	Cobol - E (88%) Assembly - B (8%) Fortran - A (4%)
652	N	C	D	D	Cobol pre-85 - E
653	N	–	E	C	C89 - B Fortran pre-91/92 - E 4GL - B
654	F	–	D	D	Assembly - A (1.6%) Ada 83 - B (5.4%) Basic 87/93 - A (0.6%) C89 - C (41%) Cobol 85 - D (51.3%) 4GL - A (0.2)
655	A	C	D	D	Ada 83 - B Basic 87/93 - D 4GL - A
656	F	B	D,E	B	Ada - E 4GL - B
657	F	B	D,E	B	C89 - A 4GL - E
658	N	–	A,B,C,D, E	D	Ada 83 - B Cobol 85 - D
659	A	B	C	B	Ada 83 - E (100%)
660	A	B	C	B	Ada 83 - E (100%)
661	A	B	D	B	Ada 83 - E (100%)
662	A	–	D	C	Ada 83 - B 4GL - E
663	A	–	D	A	C89 - D 4GL - B
664	A	–	C	C	Ada 83 - E

Table B-4. AIS Survey Data (Continued)

No.	Serv	ACAT	Phase	SLOC	Languages - Percent of Use
665	F	–	E	D	Assembly - B Ada 83 - A Cobol 85 - C Others - D 4GL - A
666	A	–	–	C	Ada 83 - C (45%) 4GL - C (45%) 5GL - C (10%)
667	O	–	C	E	Assembly - A C++ - B Cobol pre-85 - B Fortran 91/92 - B 4GL - D
668	N	A	D	–	C++ 4GL
669	N	A	D	–	Cobol 85

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LIST OF ACRONYMS

1GL	First Generation Language
2GL	Second Generation Language
3GL	Third Generation Language
4GL	Fourth Generation Language
5GL	Fifth Generation Language
ACAT	Acquisition Category
ADP	Automatic Data Processing
AIS	Automated Information System
C2	Command and Control
C3	Command, Control and Communications
C3I	Command, Control, Communications and Intelligence
COTS	Commercial off the Shelf
DARPA	Defense Advanced Research Projects Agency
DDR&E	Director, Defense Research and Engineering
DoD	Department of Defense
FIPS	Federal Information Processing Standards
HOLWG	High Order Language Working Group
IDA	Institute for Defense Analyses
IEEE	Institute for Electrical and Electronics Engineers
O&M	Operations and Maintenance
OSD	Office of the Secretary of Defense
PMI	Program Management Index
RDT&E	Research, Development, Test & Evaluation
SLAM	Standoff Land Attack Missile
SLOC	Source Lines of Code

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13. ABSTRACT (Maximum 200 words)

This study reports on a programming language survey commissioned by the Assistant Secretary of Defense for C3I to determine how many programming languages are being used in the DoD today as compared to 20 years ago when the DoD began development of the Ada language. The sample population for this survey consisted of weapons systems taken from the 1994 Presidential Budget requests for RDT&E programs exceeding $15 million and Procurement budgets exceeding $25 million. The current DoD list of major Automated Information Systems was used as the survey sample for non-weapons systems. The survey found that over 80% of the applications in the sample were written in third generation languages. Moreover, it identified 37 third generation languages in contrast to an estimate of at least 450 general purpose languages and dialects in 1974. In weapons systems modernization, Ada is the most commonly used language.

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